

LUCIA: Development of a Comprehensive Information Architecture Process Model for Websites

Arno Reichenauer

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Arno Reichenauer

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Erstgutachter: Prof. Dr. Alf Zimmer

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Summary

Web-specific usability deficiencies of websites have multiple implications: End users have been shown to suffer from disorientation and information input overload when interacting with large information systems, resulting in frustration, computer “rage”, and user abandonment. Such symptoms quickly turn into monetary losses for the sponsoring organization. Thus, an organization employing 1000 knowledge workers has been shown to lose up to US\$ 2.5 million per year, due to its employees’ inability to retrieve information on its intranet websites (Feldman & Sherman, 2001). These deficiencies can be traced back to root causes which operate and thus have to be resolved at the level of the underlying website development and maintenance processes. Current Information Architecture (IA) processes, while in fact concerned to some extent with all of these root causes, currently fail to address them methodically.

Thus, to improve both business and end user goal achievement in web-based information systems, the objective of this research was to develop a novel and unified IA Process Model describing the development of a website’s IA system (= the elements of an information system which together define the organization of and the access to its information). The results-driven approach for developing the process model involved a thorough initial analysis of IA system components, their dependencies, as well as their deficiencies for both end users and content providers. The impact of IA system deficiencies on end user goal achievement was determined through re-analysis of raw data from usability tests performed on intranet websites of the Siemens AG. For the first time, however, IA system deficiencies were also analyzed in terms of their effect on the performance of content providers (authors, editors, content managers) by conducting focused field interviews with 25 content providers. For the six components of the thereby developed IA System Model, more than 80 generic IA system deficiencies were identified that impede end users’ or content providers’ goal achievement. In addition, through focused interviews with domain experts and literature reviews, more than 50 internal (i.e., within IA system components) and 25 external (i.e., from IA-extrinsic entities) dependencies of IA system component were discovered.

Combining this IA System Model with results from literature reviews on current IA processes, process deficiencies, and applied methods, the optimized IA Process Model was developed. It was evaluated by carrying out IA expert focus groups both in Germany and the US,

and by executing a real-life IA project according to the model. Unlike any available website development process, this model for the first time:

1. Explicitly integrates standard IA processes with Database Design processes, thereby ensuring technical feasibility, minimizing design changes due to technical constraints, and allowing for deliberate trade-off decisions.
2. Actively involves content providers as a second major user group of an IA system (next to end users), which ensures feasibility and usability of the IA system for them, and thus high-quality content. As such, it integrates IA and Content Management processes.

The IA Process Model comprises an accessible description of the overall process flow, detailed specifications of individual process steps, and additional practical tools, which ensure scalability of the model to given project conditions, effective use of individual methods, and efficient interdisciplinary collaboration in web teams. It has been successfully applied in a validation project covering the redesign of a Siemens internet website. Results of the project, as well as from the expert focus groups, confirmed the IA Process Model to deliver effective and efficient IA process instances in variable conditions. It has been shown to be capable of accounting for and resolving present deficiencies of web-based information systems and their root causes, and thus provides a unique and powerful instrument to handle future challenges posed on developing web-based information systems.

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List of Acronyms and Abbreviations

C	Existing Content element in the validation project
CB	Corporate Branding
CDG	Content Development Guide
CI	Contextual Inquiry
CM	Content Management
CMS	Content Management System
CSS	Cascading Style Sheets
CP	Role: Content Provider
CT IC 7	Siemens Center for User Interface Design (department of Siemens AG)
DB	Database
DD	Database Design
DecM	Role in the validation project: Decision maker approving an employee's seminar participation
ERD	Entity Relationship Diagram
EU	Role: End User
F	Existing Functionality element in the validation project
HCI	Human-Computer Interaction
IT	Information Technology
LIS	Library and Information Science
LUCIA	Leveraging User-Centered Information Architecture
n.a.	not applicable
NC	New, additional Content in the validation project
NF	New, additional Functionality in the validation project
OSP	Online Seminar Program (Siemens website redesigned in the validation project)
PD	Process Deficiency # of IA processes
ProdM	Role: Product Manager responsible for overall seminar planning
R	(Job) Responsibility # of content providers participating in interviews
RegO	Role: Registration officer making seminar registrations for other colleagues
S	Basic usage scenario # for the validation project
SEP	Siemens Employee Portal
SBS	Siemens Business Services (department of Siemens AG)
SC	Selection Criteria # for IA methods
SD	System Development
SemP	Role in the validation project: Self-booked Seminar Participant

SemT	Role in the validation project: Seminar Trainer conducting a seminar
SL	Scalability Level for the scaling tools of the Optimized IA Process Model
TC	Key Target Criteria # for the Optimized IA Process Model
TS	Test Scenario # for usability tests in the validation project
UCD	User Centered Design
UE	Usability Engineering
UID	User Interface Design
UP	Usability Problem #, found in the case study on a Siemens Employee Portal
UR	User Research
UT	Usability Test
UX	User Experience
VD	Visual Design
W3C	World Wide Web Consortium
WWW	World Wide Web
XML	eXtensible Markup Language

1 Introduction

Long time before the advent of computers and data networks, people already struggled to find information, to preserve it, and to communicate it to others. For centuries, libraries were the only repositories for information stored in books, and librarians were the only experts to consult when specific information was needed. However, even in this circumscribed information environment, long before the information explosion in the digital era, a search for a specific information had its inherent problems, and success was not guaranteed, partly because it is hard for an information seeker to put an informational need in words and then communicate it, e.g. to a librarian (or its electronic substitute, an Online Public Access Catalog, OPAC), and partly because it is hard to index concepts and ideas so that information related to that need can be found by the librarian (Lou Rosenfeld, interviewed in Rhodes, 1999). Thus, people have been dealing with information and the problems related to finding relevant information for centuries; however, in the late 20th century, the emergence of a new medium revolutionized human use of information, and rendered much of traditional practices insufficient for the upcoming information age: the World Wide Web (WWW)¹.

Originally, the web was conceived by Tim Berners-Lee, a researcher at the Conseil Européen pour la Recherche Nucléaire (CERN), in the late 1980s as a means to connect CERN researchers all around the world, in order to enable them to distribute and share their scientific knowledge (Morrogh, 2003). Nowadays, the web has turned to one of the most important media and sales channel, but one which “is all about the power of movement” (Vodvarka, 2000, p. 3): the connection of single informational “nodes” through “links” turns a collection of resources into a whole web of interconnected, actively traversable resources. By that, the web gives much more control to the information seeker than traditional media: whereas with books, newspapers or television, the user is restricted to turn the page or switch the channel to obtain fixed informational offerings, the web allows for direct control of the user over *what*

¹ In this thesis, the terms *World Wide Web*, *the web*, and the acronym *WWW* are used synonymously to refer to the part of the Internet that is based on the Hypertext Transfer Protocol.

this medium delivers to them, *when* it delivers it and *how* it is presented on the screen (Vodvarka, 2000; Nielsen, 1999). At the same time, however, this implies more responsibility on the user's side: they have to make judgments and take actions on their own, with the content and functionality delivered by their system as the only support.

As such, the praised new medium also involves some inherent, hardly to resolve deficiencies. Thus, for example, the sheer amount and diversity of available information, together with its often-questionable quality due to the ease of publication on the web, provoke symptoms of information input overload with users (see 2.3.2.1 and 2.3.5.2). This overload of information, together with the increased need to actively control the medium, and the constantly changing macro- and microstructure of the web, results in end users frequently having problems with finding relevant information on the web. The main modes to find information on the web, browsing and searching, both pose specific problems and challenges on finding information, e.g., insufficient search results or too complex navigation structures, which often results in users feeling lost in the overall information space (see 2.3.2.2 and 2.3.5.2). Finally, constraints also stem from characteristics of the web's technical realization, with system response delays being one of the most common problems (see 2.3.2.3).

These deficiencies of websites quickly turn into monetary losses for the sponsoring organization, for example by abandoned online shopping carts, lost customers, or wasted employee work time. Thus, for intranet environments, Feldman and Sherman (2001) have shown that, per year, an organization employing 1000 knowledge workers loses US\$2.5 million due to its employees' inability to retrieve information. As a result, one of the most important determinants for a website to be competitive and successful, more than in any other medium, is how well the user gets along with the medium, or put in more formal words, how *usable* the website is: the degree to which the user can achieve specific goals with effectiveness, efficiency, and satisfaction (see 2.2.6.1). As many goals are informational goals on the web, the quality of the information itself in terms of respective end user requirements plays a significant role in web usability (e.g., Nielsen, 1999). In sum, many factors, from human- to information- to technology-dependent aspects, make information seeking on the web more difficult than with traditional media, which promoted in the mid 1990s the emergence of a distinct profession dedicated to "help[ing] people find and manage information" (Rosenfeld & Morville, 2002, p. 4): Information Architecture (IA).

Rooted in this discipline, the present thesis aims at improving both end user and thereby business goal achievement in web-based information systems by minimizing the occurrence

and thus alleviating the impact of web-specific deficiencies. Capitalizing on and expanding beyond respective concepts of Psychology and Human-Computer Interaction, this thesis is focused on how to practically handle such deficiencies within an overall, industry-typical website development cycle. As such, the thesis diverts from the often mainly analytical research approach found in much psychological research, in that it utilizes its analytical findings regarding those deficiencies as an initial basis for a subsequent, additional creative stage of deriving a generic solution for the issues addressed.

The overall structure of this thesis comprises seven major chapters. In the following Chapter 2 on the theoretical background of this thesis, the actual state of the discipline of Information Architecture (2.1) is described, as well as related disciplines in website development and mutual relationships (2.2). In addition, the current state of research on web-specific deficiencies, their root causes, and their consequences, is presented in Chapter 2.3. With this groundwork, in Chapter 3, the research approach for this thesis is developed, detailing the purpose and objectives of the thesis. Chapter 4, then, covers the actual realization of the research approach, and thus describes the development and evaluation of the targeted IA process model. Final results of this thesis are then introduced in Chapter 5, while Chapter 6 provides a discussion of these results and the methodological approach employed, together with suggestions for future research. The bibliography constitutes Chapter 7. In the subsequent appendix, detailed research findings, materials used in the realization, as well as details of preliminary and final results of the thesis are listed.

2 Background

2.1 The Discipline of Information Architecture

2.1.1 The History of Information Architecture

While there is still discussion about the actual definition of IA (see chapter 2.1.2), consensus reigns about the origin of the phrase “information architecture”: Richard Saul Wurman, a trained architect interested in the ways in which information about urban environments could be gathered, organized, and presented in meaningful ways, coined the term “Architecture of Information” in 1976. Back then, he served as the chair of the national conference of the American Institute of Architects and chose “The Architecture of Information” as the conference theme (Hill, 2000; Wyllys, 2000; Ewing, Magnuson, & Schang, 2001; Dillon, 2002). He also co-edited a book called “Information Architects” (Wurman & Bradford, 1996), in which he describes the information architect as:

1. The individual who organizes the patterns inherent in data, making the complex clear.
2. A person who creates the structure or map of information which allows others to find their personal paths to knowledge.
3. The emerging 21st century professional occupation addressing the needs of the age focused upon clarity, human understanding, and the science of the organization of information.

(Wurman & Bradford, 1996, [quotation from the book’s jacket])²

The actual origin of Information Architecture however is more difficult to date, as information has been structured by humans “ever since a stylus was first applied to a clay tablet” (Lou Rosenfeld, interviewed in Hill, 2000, ¶ 21). According to Toms (2002), the roots of IA can be traced back to theories of classification and the organization of knowledge, categorization, menu design research, and hypertext navigation. These topics refer back to two of the major rooting disciplines for IA, Library & Information Science (LIS; see 2.1.2.3) and Human-

² For more on Wurman’s view, and how it relates to current conceptualizations of IA, see 2.1.2.1 and 2.2.3.2.

Computer Interaction (HCI, see 2.1.2.5). Further input however is drawn from various other established, but also rather distinct disciplines, which focus on information in some way, like Computer Science, Graphic Design, and many more (Morrogh, 2003; Rosenfeld, 2001b; see Figure 2-1).

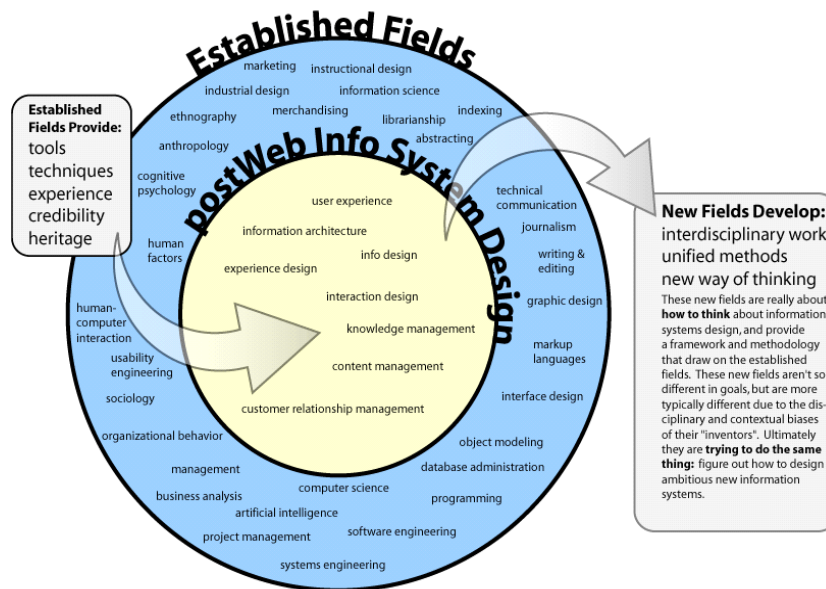


Figure 2-1: Post-web information system design (Rosenfeld, 2001b)

The explosive growth of the internet in the late 1990s, however, enforced cross-disciplinary solutions to information design problems, and thus gave rise to the new discipline (Ewing et al., 2001; Dillon, 2002; Morrogh, 2003). An important milestone marked the release of “Information Architecture for the World Wide Web” by Lou Rosenfeld and Peter Morville (1998), the grounding book on IA.³ Another major breakthrough point for the formation of a professional discipline was the first Information Architecture Summit in May 2000 at Boston, a since then annually held conference of IA professionals (Dillon, 2002; Kalbach, 2003). The American Society for Information Science and Technology (ASIS&T) dedicated a special issue of its journal JASIST to the emerging field (Vol. 53, No.10), and hosts a vibrant Special Interest Group on Information Architecture (SIG-IA). There are regular columns on IA (e.g. Andrew Dillon in the Bulletin of ASIS&T), and the first online, peer-written journal dedicated especially to Information Architecture, www.bboxesandarrows.com, debuted on March 11, 2002. The Asilomar Institute for Information Architecture (AIIA, www.aifia.org), a non-profit volunteer organization devoted to advancing and promoting IA worldwide, was launched in November 2002.

³ In 2002, the second edition of this book was published.

2.1.2 Definitions of Information Architecture

2.1.2.1 Wurman's Conception of Information Architecture

While Wurman was the first to use the phrase “information architect” back in the late 1970s, there is evidence that his interpretation of the term is not matching today's usage: some leaders in the field think that what Wurman delineated as IA is rather called Information Design now (Peter Morville, interviewed in Hill, 2000; Lou Rosenfeld, interviewed in Lisberg, 2000; Merholz, 2001; Wodtke, 2004): According to them, Wurman concentrates on the presentation and layout of information on a two-dimensional page, while information architects today focus on structure and organization of information mostly in online environments, where “Wurman's definition of information architecture doesn't really scale well” (Lou Rosenfeld, interviewed in Lisberg, 2000, p. 4; also Peter Morville, interviewed in Hill, 2000; Victor Lombardi, as cited in IAwiki, 2003).⁴

As a result, there is an ongoing and heated debate about finally defining IA ever since the first IA Summit at Boston in May 2000, aptly entitled “Defining Information Architecture”. Partly because it is a very new concept, partly because there are many disciplines and therefore views involved, it is difficult for the IA community to settle down on this issue (Ewing et al., 2001). According to the *IAwiki* (2003), a collaborative online knowledge base for IA, there are at least two major splits in IA definitions, characterized by the professional background they emanate from:

1. A LIS-flavored IA focusing on the structure of information (“Library-IA”)
2. A HCI-flavored IA that additionally includes an (often user-centered) design of support systems around the information structure (“Interaction-IA”, “User-Centered-IA”)

In contrast, another potential variable, the (product) domain that IA covers, seems to be quite settled: there is a huge agreement that current IA focuses on websites (Hill, 2000; Merholz, 2001; Rosenfeld & Morville, 2002; Wodtke, 2002a), if however the concepts of IA can easily be applied to a wide array of information products, including CD-ROMs, workstations, and mobile devices, such as cell phones or pocket PCs (Kalbach, 2003; Dillon, 2002; Lillian Svec, Arnie Lund, as cited in Morrogh, 2003).⁵ For the purpose of this thesis, therefore, the focus of IA is generally referred to as information systems, with websites being the most prominent and most frequent application domain.

⁴ For more on Information Design vs. Information Architecture, see 2.2.3.2.

⁵ For future trends in this respect, see 2.1.7.

Information System and Website

Definition: An *information system* is a combination of hardware and software components which collects, processes, stores, transmits, displays, disseminates, and acts on information.⁶

Definition: A *website* is an information system that is based on a client/server network that uses HTTP as its transaction protocol. The network may be public (internet websites), semi-public (extranet websites), or private (intranet websites)⁷.

When talking about definitions for IA, however, it is important to note that there is another trait that IA definitions can be differentiated along, being the various aspects of the overall concept “information architecture”. Definitions can deal with IA as:

- a **system**, part of an overall information system (“the IA of the website”)
- a **process** resulting in this system (“the IA development process”)
- a **role** within that development process (“the information architect of the team”)
- a **discipline** (or craft/community of practice: “IA has matured in the last years”)

To subsume, definitions of IA vary in at least two ways, being (1) the professional background they originate and (2) the aspect of the concept they address. In the following, three major lines of thought for IA are discussed in light of these two variables: Library-IA (a.k.a. “Small IA”), Interaction-IA (a.k.a. “User-Centered-IA”), and “Big IA”.

2.1.2.2 Library-IA (a.k.a. “Small IA”) and User Experience Design

Coined “Small IA” by Peter Morville (2000a), here the discipline of IA is viewed as being focused on the structural organization of information. This is reflected in the definitions that Lou Rosenfeld and Peter Morville (both librarians by trade) provide in their second edition of “Information Architecture for the World Wide Web” (2002); IA thus can be defined as:

1. The combination of organization, labeling, and navigation schemes within an information system [IA as a system; see 2.1.3.1 for more on these components].
2. The structural design of an information space to facilitate task completion and intuitive access to content [IA as a process].
3. The art and science of structuring and classifying websites and intranets to help people find and manage information [IA as a discipline].
4. An emerging discipline and community of practice focused on bringing principles of design and architecture to the digital landscape [IA as a discipline].

(Rosenfeld & Morville, 2002, p. 4)

⁶ For the purpose of this thesis, *data* can be defined as “organized input from the senses” (Marcus, 2002, p. 23), including raw numbers, facts, and figures (Albers, 2003). *Information*, in turn, is made up of “significant patterns of organized data” (Marcus, 2002, p. 23); it includes text, sound, and (moving) images (Boiko, 2002). *Content* includes any information and functionality contained in a system (Boiko, 2002; Rosenfeld & Morville, 2002).

⁷ This terminology is in line for example with Rosenfeld & Morville, 1998. In this thesis, the terms *website* and *web-based information system* are used synonymously.

Rather than addressing the screen-level presentation of information, these definitions mirror traditional librarianship tasks of classifying and arranging distinct information entities (e.g., books), as opposed to designing the presentation of information within a single book.

The notion of Library IA thus being a rather focused part of the whole website development process triggers the question of how this IA relates to other aspects of the website, e.g. the user interface or the visual design. Garrett (2000) describes IA as one element of the overall user experience (UX) of a website (see Figure 2-13 on page 44). A user's experience can be defined as the "lasting impression formed while interacting with a system's varied attributes" (Marshak, 2004, p. 3), including for example a system's content, functional behavior, layout, visual design, navigation, and system robustness, but also other things like how it is advertised, or the tone of language used (Vodvarka, 2000; Garrett, 2002a; Jakob Nielsen, interviewed in Thornton, 2002; Kuniavsky, 2003a; Marshak, 2004). In turn, IA, as part of this general user experience, is narrowly defined in a Library-IA sense as the "structural design of the information space to facilitate intuitive access to content" (Garrett, 2000, *Web as hypertext system*, ¶ 9).⁸

2.1.2.3 Excursus: Roots of IA (I): Library & Information Science (LIS)

While Library Science can be described as "the study or the principles and practices of library care and administration" (Merriam-Webster Online Dictionary, 2003, keyword: library science), Information Science more generally deals with "the collection, classification, storage, retrieval, and dissemination of recorded knowledge treated both as a pure and as an applied science" (Merriam-Webster Online Dictionary, 2003, keyword: information science). Accordingly, the merged Library and Information Science (LIS) significantly overlaps with IA; at the highest level, they both aim at matching an information need with an information resource (Kalbach, 2003). As mentioned before, LIS principles of organizing information (e.g., subject access, formats and records, and description syntax) provide a major fundament for the theory and practice of IA (Ewing, Magnuson, & Schang, 2001; IAwiki, 2003; Victor Lombardi, as cited in IAwiki, 2003a). Skills and techniques of LIS are especially valuable for designing metadata schemata and controlled vocabularies (Victor Lombardi, as cited in IAwiki, 2003a).⁹ From an LIS perspective, IA is occasionally viewed as being virtually identical to LIS, topped with a "fillip of graphic design and fresh thinking" (Wyllys, 2000, ¶ 25) - and accordingly is

⁸ For more on the relationships between user experience elements and the respective disciplines, see 2.2.

⁹ For more on metadata schema and controlled vocabularies, see 2.1.3.2.

considered a continuation of LIS in the digital world. There are, however, significant differences between IA and LIS, as Kalbach (2003) notes:

Matter: While librarianship is traditionally concerned with conventional document formats and graphic records, IA focuses on digital information; this also involves an influence capability on authorship (amount, type, and format of information) not known in librarianship, which rather concentrates on management of already existing documents.

Time: Whereas information architects frequently work on a project-per-project basis and on “highly accelerated time scales” (Kalbach, 2003, ¶ 15), librarianship is a rather ongoing maintenance process. Librarians can draw from a long tradition with evolved standards and methods, while information architects have to develop creative and completely new organizational systems.

Space: Traditional librarians reside in and are much more involved with one physical place, the library, which has no physical, at most a digital counterpart in IA.

Energy: While both focus on organizing and finding information, information architects are much more concerned with the user experience when directly interacting with the system.

Audience: Librarians know their audience often quite well, even on a personal basis, whereas information architects generally deal with an anonymous target audience, which requires user-centered design, rather than content-centered design, as is the case for libraries.

2.1.2.4 Interaction-IA and “Big IA”

Some experts take on a broader approach in defining IA. Thus, Lund (2001, ¶ 2) defines IA (as a system) as “the underlying organizational structure for a system of content and interactions”. This noticeably extends the concept of IA also to cover the structural design of user-system interactions; for exponents of “Small IA”, however, this notion of IA rather describes a “hybrid of IA and Interaction Design” (IAwiki, 2003b).¹⁰ This hybrid character is made explicit by Wodtke (2001a): Consolidating a huge collection of IA definitions, she developed a comprehensive model for (Interaction-)IA (as a discipline) which also includes screen-level information and user interface design as a third element:

- Content Architecture: organization of information for easy retrieval¹¹
- Interaction Design: architecting task flows and behaviors for use¹²

¹⁰ For more on the discipline of interaction design and its relationships with IA, see 2.2.2.

¹¹ Similar to “Small IA”: IA as described in Rosenfeld & Morville, 1998; see 2.1.2.2.

- Information Design: organizing information for comprehension; user interface design¹³

A yet broader conceptualization of IA is commonly referred to as “Big IA”. In this view, an information architect can be defined as follows:

Based on the desires, wants, needs, goals, and knowledge base of a user, the Information Architect determines the solution features and creates intuitive page-level organizational models and interaction design processes; all of which are organized by identifying the overall site structure. It is a prime directive of the Information Architect to identify the requirements of the other development disciplines in order to maintain the integrity of the final product and user experience. (Rare Medium LCC, 2002, ¶ 3)

This definition points to the widespread responsibilities of a “big” information architect as “an orchestra conductor or film director, conceiving a vision and moving the team forward” (Gayle Curtis, as cited in Morville, 2000a, ¶ 26), including business strategy, information design, user research, interaction design, requirements gathering, and other tasks (Garrett, 2002).

All in all, Interaction-IA and “BigIA” extend the focus of IA to also include the design of interaction flows (e.g. the registration flow of pages at www.ebay.com) and screen-level organization of information and interface design (e.g. design of EBay’s homepage), if however, the structural organization of information focused on in “SmallIA” is seen as the founding element (Wodtke, 2001a; Rare Medium LCC, 2002).

2.1.2.5 Excursus: Roots of IA (II): Psychology and HCI

It has been mentioned before that IA, especially in an Interaction-IA sense, has roots in different branches of psychology (see 2.1.1), including Organizational Psychology (Ewing et al., 2001), Engineering Psychology and Human-Computer Interaction (HCI; Rosenfeld, 2001b; Morrogh, 2003), and Cognitive Psychology (Hill, 2000). Psychology, at its core, can be defined as “the systematic study of mental processes and behavior” (Westen, 1996, p. 3) or “the science of mind and behavior” (Merriam-Webster Online Dictionary, 2003, keyword: psychology). It studies conscious processes and conditions of the mind as well as their causes and effects (Rohracher, as cited in Dorsch, 1998).

Engineering Psychology

Often referred to as Human Factors, Engineering Psychology emerged during the middle of the 20th century to address the increasingly problematic relationship between humans and technology especially in workplace environments (Greif, 1998; Morrogh, 2003). Accordingly,

¹² Interaction design as described in Cooper & Reimann, 2003; see 2.2.2.

¹³ Similar to Wurman’s definition of IA; see 2.2.3. For more on user interface design, see 2.2.6.2.

it aims at optimizing human use of products, equipment, machines, and large-scale systems by applying knowledge of human behavior and physical attributes; in doing so, it draws from a number of other disciplines, such as physiology, biomechanics, and anthropology (Cushman & Rosenberg, 1991; Morrogh, 2003). The practice of integrating human factors expertise in the overall product development process is frequently referred to as Usability Engineering.¹⁴

Human Computer Interaction (HCI) & Information Architecture (IA)

With the rise of computer technology during the 1970s, the scope of Engineering Psychology was extended also to include human use of computers. Finally, this resulted in a new sub-branch called Human-Computer Interaction (HCI). Rooted in psychology as well as computer science and software ergonomics, it aims at designing computer systems that are practical, efficient, and easy to use. In the past, this involved developing models of human-computer interaction, as well as the design of input / output devices (hard- and software: e.g., the mouse, or menu displays). Especially since the advent of the World Wide Web, however, HCI increasingly addresses the design of virtual and distributed computing environments, including websites and other multimedia applications (Hamborg, 1998; Morrogh, 2003).

In this line, the discipline of IA can be seen as a natural extension of HCI that focuses primarily on organizing information for ease of retrieval (Morrogh, 2003; Anderson, R., 2002). Information Architecture draws from the huge knowledge pool of HCI, as well as it takes over research and testing methods that were developed within the discipline (Peter Morville, interviewed in Hill, 2000).¹⁵

Locating IA concepts within the overall process of human-computer interaction, Toms (2002) contends that an IA system performs a major supporting role during three key stages: selecting a category, noting relevant cues, and extracting information (see Figure 2-2). Successful completion of these three tasks performed by the end user is largely dependent on the IA system, as each is stimulated by and results from its micro-level (e.g., the structure of a piece of text supporting information extraction) and macro-level structures (e.g., a navigation menu supporting category selection and cue recognition; Toms, 2002).¹⁶

¹⁴ For more on the discipline of Usability Engineering, see 2.2.6.

¹⁵ For more on HCI and Usability Engineering methods in IA, see 2.2.6.3.

¹⁶ For models of human-computer interaction, see for example Dix, Finley, Abowd, & Beale, 1993; Norman, D.A., 1986; 1988).

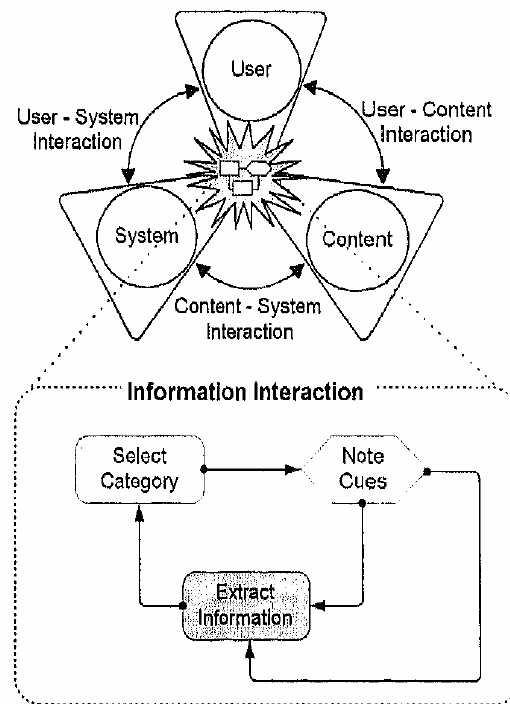


Figure 2-2: An instance of information interaction (Toms, 2002, p. 859)

Cognitive Psychology & Information Architecture

Cognitive Psychology is a branch of psychology concerned with the process and products of human cognition, including perception, memory, learning, problem solving, decision making, reasoning, and language, among others (Häcker & Stapf, 1998; Anderson, 2000). Withrow characterizes the relationship of cognitive psychology and IA as a transgression “From Theory to Practice” (Withrow, 2003, p. 1), as many of the results of cognitive psychology research can readily be translated to IA practice, including (1) human categorization, (2) visual perception, and (3) memory.

(1) *Categorization*: A *category*, in the context of human perception and cognition, has been defined as “a partitioning to which a certain assertion or assertions apply” (Medin & Goldstone, 1990, p. 77). In turn, a *concept* is the mental representation of a category (Medin & Heit, 1999). *Categorization*, the act of assigning something to a category, is ubiquitous in everyday life; it “provides the gateway between perception and cognition” (Barsalou, 1992, p. 15): whenever a stimulus reaches one of the perceptual systems (be it visual, auditory, tactile, gustatory, olfactory, or proprioceptive system), categorizing the information, and thus assigning a mental representation to it, constitutes the basis for most, if not all subsequent cognitive processes, including understanding, reasoning, and communication (Medin & Goldstone, 1990; Medin & Heit, 1999). Categorization thus allows human beings to decompose the diversity and complexity of their surroundings into manageable, organized structures of con-

cepts (Barsalou, 1992; Eysenck, 1984). Much research has been invested to reveal how these concepts are structured and how categories are processed. According to Medin and Heit (1999; Medin & Goldstone, 1990; Barsalou, 1992), three basic positions are held up to now:

The *classical view* claims that concepts are organized around defining features, which each are singly necessary, and jointly sufficient to define the concept. Category membership, then, might be decided on by testing rules derived from these features.¹⁷ This all-or-none view is especially appropriate when costs of incorrect category membership assignment are high, and strict rules are helpful to avoid them (Medin & Goldstone, 1990; Barsalou, 1992).

The *probabilistic view* denies such absolute limits to concepts, and rather proposes that there are several characteristic, but individually not inevitably necessary properties that constitute a concept and thus form a so-called “prototype”¹⁸. An instance, then, can be a better or poorer member of such a concept.¹⁹ This view is especially useful if instances of a category vary broadly and have few or no attribute values in common (Barsalou, 1992).

The *exemplar view* agrees on the notion of characteristic but not inevitably necessary properties, but also contends that concepts can be represented by their individual instances, and membership is defined in terms of similarity to these specific examples.²⁰

However, categorization may also be driven by additional factors, e.g., innate categories²¹, subjective and intuitive theories²², or individual and temporary goals and expectations (Medin & Goldstone, 1990; Barsalou, 1992; Medin & Heit, 1999; Withrow, 2003). In sum, human category processing is only incompletely understood until now (Barsalou, 1992). While everyday experience suggests that all of the models presented above are true to some extent, research on concepts and human categorization has not yet presented a theory integrating the various, partially verified models, although some results suggest that categories “have multiple representations, each of which operates in certain settings” (Barsalou, 1992, p. 30).

¹⁷ Example: The category “even numbers” is defined by the attribute “evenly divisible by two”; a testing rule might be: ‘If the number is evenly divisible by two, then it is an even number’ (Medin & Goldstone, 1990).

¹⁸ A prototype can be defined as a “single, centralized, category representation” (Barsalou, 1992, p. 28). It may include information about a category’s average or most frequent attribute values, or even value distributions.

¹⁹ Graded membership, i.e., an instance of a concept can possess many or only a few of the characteristic attributes; example: a penguin is a poorer member of the category “birds” than a robin, also because it cannot fly, but it still is one.

²⁰ Example: The concept “bachelor” might be represented with memories of one or several specific bachelors (Barsalou, 1992).

²¹ Innate categories: categories that have not to be learned.

²² For example, theories on the relevance of individual attributes for determining category membership.

Given this assertion of multiple mechanisms amounting to a complex, inter- and intra-individually variable category processing system, Withrow (2003, ¶ 4) claims that in developing IA systems, the ideal solution would be to “accommodate as many different categorization approaches as possible”. However, as most information systems come with only one system of categories, it is vital for the information architect to match this category system as closely as possible with end users’ average conceptual structure, which can be achieved by performing card-sorting exercises with representative users (see 2.1.5.2).

(2) *Visual perception*: Perception can be defined as referring to “the means by which information acquired via the sense organs is transformed into experiences of objects, events, sounds, tastes, etc.” (Roth, 1986, p. 81, as cited in Eysenck & Keane, 2000, p. 25). Perception of visual stimuli is thus a process in which sensory input from the eyes is translated into a subjective experience of the physical environment (Anderson, 2000). However, visual perception is not a purely linear, one-way, but rather dynamic process, combining bottom-up, data-driven processing mechanisms with top-down, concept-driven processing mechanisms (Foley & Moray, 1987; Marks & Dulaney, 1998). Thus, each single perception is the product of sensory input and the observer’s interpretation of this input (Anderson, 2000; Marks & Dulaney, 1998; Foley & Moray, 1987).

The top-down portion of visual perception is governed by several determinants, including Gestalt principles, long- and short-term expectations, and attention (Foley & Moray, 1987). Gestalt principles have been introduced to explain the issue of perceptual segregation and object recognition (Ehrenfels, 1960; Arnheim, 1974; Eysenck & Keane, 2000; Anderson, 2000). Among these principles are the laws of proximity, similarity, good continuation, and closure²³ (see Figure 2-3).

²³ Figure 2-3 illustrates these Gestalt laws:

- (a) Law of proximity: elements close in time or space tend to be perceived as belonging together; thus, in this arrangement, from left to right, line one and two form a unit, three and four, etc.
- (b) Law of similarity: like elements (all the “x” vs. all “o”) tend to be perceived as forming a unit; thus this arrangement is rather perceived as four lines than five columns.
- (c) Law of good continuation: elements that compose a continuous smooth direction tend to be perceived as a unit; thus, two lines are perceived, one from A to B, and the second from C to D, although this could show lines from A to C and B to D.
- (d) Law of closure: the missing parts of a figure are filled to complete it; thus, two circles are perceived, the left one being covered partially by the right circle, although the hidden part of the left element could have any other form.

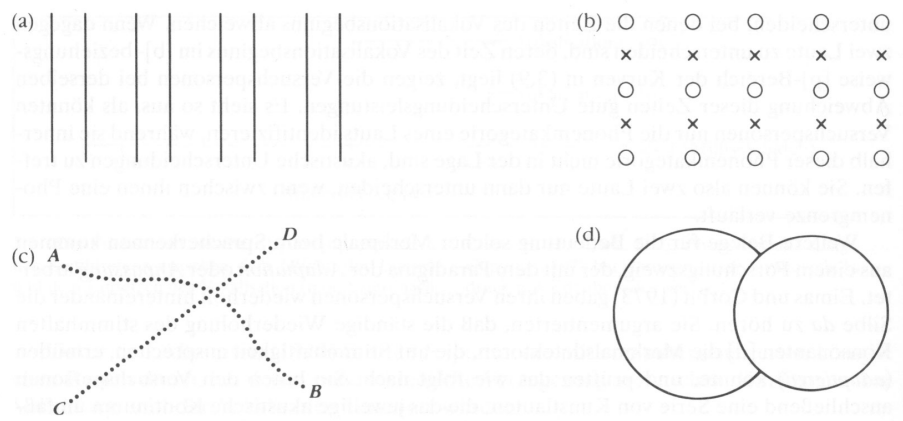


Figure 2-3: Gestalt principles in visual perception (Anderson, 2000, p. 64):
Laws of (a) proximity, (b) similarity, (c) good continuation, and (d) closure²³

These Gestalt principles seem to “impose structure on incoming information and force perception into certain modes” (Foley & Moray, 1987, p. 64). Thus, the more visual information conforms to Gestalt principles, the easier it is to process; the less it conforms, the more likely perceptual errors become. This also plays a major role in the interaction of a human with a computer interface (Foley & Moray, 1987; Withrow, 2003). Withrow (2003) points to the importance of the principles of proximity and similarity for the design of navigation systems: for example, items of a second-level navigation bar need to be aligned through similarity and proximity to each other and to the superordinate first level navigation element, in order to achieve a perceptual association.

(3) *Human memory*: According to the spatial metaphor for the basic structure and processes of human memory, information is stored in specific locations within the mind, and retrieval of information involves a search through the mind (Eysenck & Keane, 2000). Thus, at least three types of memory stores are supposed to operate in human memory, as for example described by Atkinson and Shiffrin (1968): sensory stores, short-term memory, and long-term memory.

A popular but ultimately flawed application of cognitive research to the design of information systems concerns short-term memory span. In a classical study, Miller (1956) found that participants could hold about seven single information units in immediate memory, regardless whether the units were numbers, letters, or words. However, the application of this “magical number 7+/-2” to the design of navigation systems, resulting in the golden rule of

not more than nine elements on each level of a navigation system, has been criticized by various authors as an unduly transfer of Miller's findings, for a number of reasons:²⁴

- Navigating a website is much less a task involving memory rather than perceptual resources, as long as navigation elements are persistently presented on the screen.
- Even if memory resources are involved, the interaction with a web interface is a completely different setting than in Miller's experiments: there are far more visual stimuli on a website, and the stimulus material (i.e., the website's content) is much more meaningful to the user than typical research stimuli.
- Subsequent research revealed additional factors determining short-term memory span, e.g., length of words, mode of presentation, degree of relations between information items, among others .
- Although Miller's study was very influential in shaping the theory of short-term-memory back in the 1950s and 60s, the concept of a distinct short-term memory has since then been challenged and partly replaced by dissenting views on human memory, e.g. the model of a working memory.

(Baddeley, 1994; Shiffrin & Nosofsky, 1994; Anderson, 2000; LeCompte, 2000; Kalbach, 2002; Withrow, 2003)

In contrast, long-term memory does play a significant role in online navigation. According to the theory of semantic networks (e.g., Quillian, 1966, as cited in Anderson, 2000), conceptual knowledge resulting from categorization is stored in human long-term memory in a hierarchical network structure, with attributes attached to the most generic concept they apply to (see Figure 2-4).

Whenever a user scans the labels in a list of navigation elements, corresponding nodes in the network are activated (Withrow, 2003). According to the theory, activation spreads outward from activated nodes along the paths to other nodes until the energy for that activation has run out (Anderson, 2000). A user thus might choose a particular link because it offers the best "information scent", a maximum of associative linkage and activation spread between the link's label and the representation of his information need in the semantic network (Chi, Pirolli & Pitkow, 2000; Withrow, 2003). Again, this proves the need for IA system to be modeled according to users' conceptual representations of the relevant knowledge domain, e.g., by performing card sorting exercises (Withrow, 2003; see 2.1.5.2).

²⁴ For recent research results on depth vs. breadth of menu structures, see 2.3.2.2.

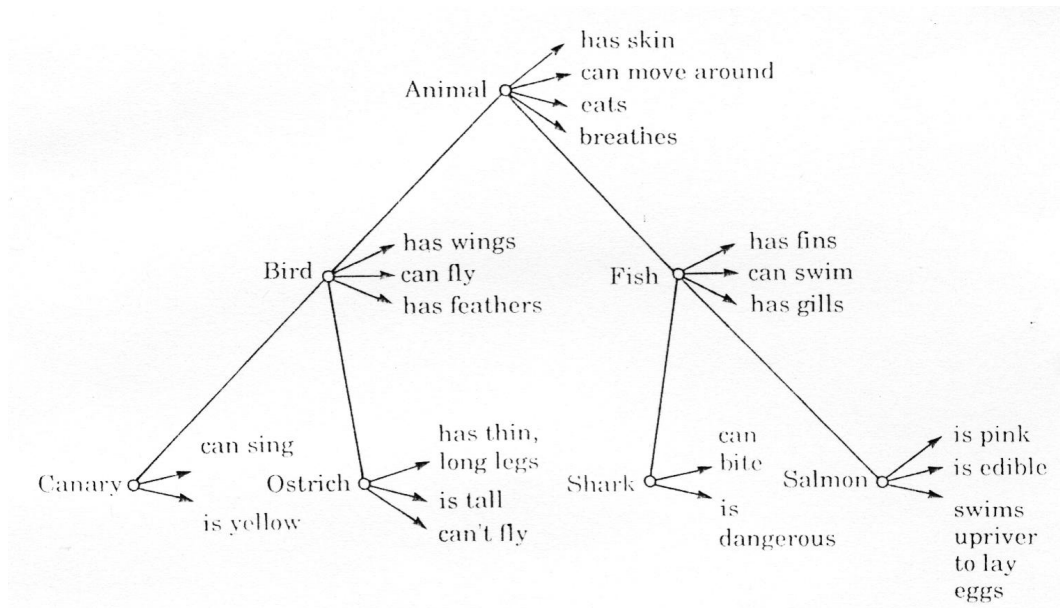


Figure 2-4: Partial semantic network (Eysenck, 1993, p. 84)

2.1.2.6 Conclusion on Information Architecture Definitions

The discussion about the definition of IA keeps erupting in IA discussion forums and at conferences as well. Although meanwhile questioned by some (see for example Mazur, 2001), many IA professionals still believe that precise definitions are needed in order for the discipline to progress (e.g., Merholz, 2001; Garrett, 2002). To increase the chance for consensus, a first step (which also has been pursued in the previous chapters) is to state explicitly which aspect of the concept IA (system, process, role, or discipline; see 2.1.2.1) is actually defined. Garrett (2002) elaborates on this, analyzing the dilemma of role vs. discipline definitions, which in his view are not exchangeable. He proposes to separate them altogether, and define the *discipline* of IA narrowly and in accordance with “Small IA” views, while the *role* of an information architect would be better described broadly in Interaction-IA or “Big IA” terms.²⁵ In the remainder of this thesis, Garrett’s approach is taken as a starting point, if however, separate definitions for the *system* and *process* of IA will be devised.

²⁵ Garrett (2002) points out that describing the discipline of IA by the role tends to result in definitions “too broad to foster useful discussion of the discipline” (Garrett, 2002, ¶ 13), while the other way around, defining the role by the discipline, definitions soon become too narrow to cover what an information architect’s job is about. He compares the proposed definitions for the role and discipline of IA with an orchestra conductor’s broad *role* with a wide range of creative and managerial responsibilities and the narrow *discipline* of conducting that orchestra.

2.1.3 The System of Information Architecture

2.1.3.1 Components of an Information Architecture System

According to Rosenfeld and Morville (2002), an IA system is made up of four components: organization, navigation, labeling, and searching systems. *Organization systems* focus entirely on the logical grouping of information. They are composed of organization schemes and organization structures. An *organization scheme* specifies the attribute whose possible attribute values determine exact or ambiguous classes into which items are then sorted.²⁶ An *organization structure*, in turn, defines how these individual classes relate to each other and thus form a coherent whole, the structure (Rosenfeld & Morville, 2002, pp. 50-75).²⁷

Labeling systems define how classes are called. Labels, either textual or iconic, are used in an IA system to efficiently represent larger portions of information, e.g., as headings, navigation elements, contextual links, or index terms (Rosenfeld & Morville, 2002, pp. 76-105).

Navigation systems provide paths through the organization structure. *Embedded* navigation systems, including global, local, and contextual navigation, are integrated in actual content pages of the website; *supplemental* navigation systems, including sitemaps, indexes, and wizards, exist on separate pages (Rosenfeld & Morville, 2002, pp. 106-131).²⁸

Search systems enable users to formulate a query, match it with, and present links to and brief descriptions of relevant documents.²⁹ A search system is made up of search engine and search interface. A *search engine* is software capable of automatically indexing and searching content. The *search interface* provides a search query input mechanism and presents results to the user (Rosenfeld & Morville, 2002, pp. 132-175).

²⁶ Examples for exact organization schemes are alphabetical, chronological, or geographical order; ambiguous schemes include order by topic, audience type, metaphor, or along a task flow (Rosenfeld & Morville, 2002).

²⁷ Examples include the hierarchy-, the database-, and the hypertext model (Rosenfeld & Morville, 2002).

²⁸ *Global* refers to the set of choices visible on every page of a website, i.e., the *primary, top-level navigation* within the organization structure, but also *utility navigation* (e.g., “Help”, “Contact”) and *footer* (list of links at the bottom of each page); *local* refers to the submenu of one top-level element of the primary navigation; *contextual* refers to links within a document of the website (similar to a cross reference); a *sitemap* provides a condensed overview of and links to major content areas; an *index* presents an (often alphabetically) ordered list of words and phrases which link to associated content; a *wizard* leads users through a sequential series of screens or dialogue boxes to complete a task (Bollaert, 2001; Rosenfeld & Morville, 2002; Young, 2002)

²⁹ According to Rosenfeld & Morville (2002), search systems can also be viewed as a further supplemental navigation system. This has led to contradictory descriptions of IA system components and respective user activities. In line with most of the literature, in this thesis, a *search system* as part of an IA system is treated as distinct component, next to navigation systems (see also the final IA System Model in 5.2); however, the user activity of *searching* a website is subsumed with *browsing* under the act of *navigating* a website (see 2.3.2.2)

Rosenfeld and Morville (2002, pp. 46-49) also provide an alternative approach, which accounts for metadata and controlled vocabularies as additional components of an IA system:

1. *Browsing aids*, including organization and navigation systems
2. *Search aids*, including the search interface and search engine components
3. *Content and tasks*, including headings, embedded links, metadata schemata, and more
4. *Invisible components*, including controlled vocabularies and rule sets

However, this might also be achieved by introducing an additional fifth component “Content” to their original model, as proposed by Alison J. Head (interviewed in Rhodes, 2001b).

While this focus on metadata and controlled vocabularies is characteristic for the underlying Library-IA approach, in Interaction-IA (see 2.1.2.4), IA system models are rather extended insofar as to also to include interaction flows and screen-level organization of information and design (Vodvarka, 2000; see also Wodtke, 2002; Reiss, 2000; Lund, 2001).

Aligning both approaches, Forsman (2003) introduces a comprehensive framework for IA made up of seven elements (see Figure 2-5). Here, element #2 and #4 include Interaction-IA’s screen-level organization and design, while elements #5 to #7 cover Library-IA’s “invisible components”, as in Rosenfeld & Morville’s (2002) alternative model.

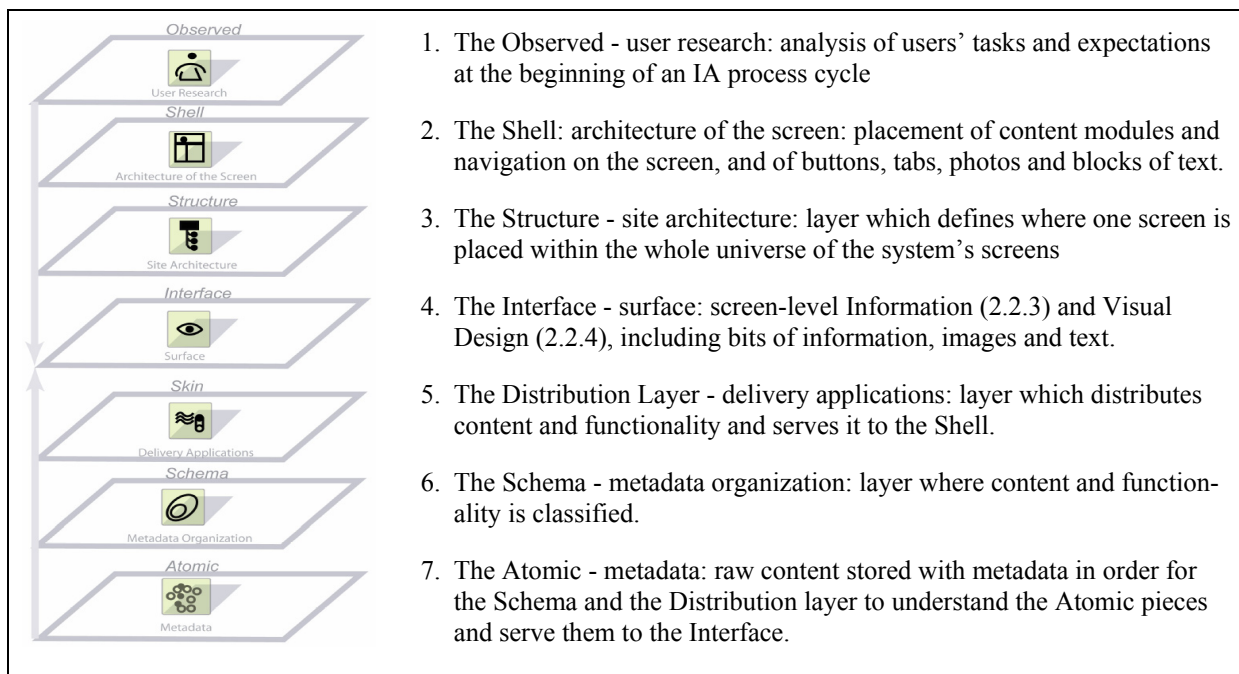


Figure 2-5: An Information Architecture Framework (Forsman, 2003, p. 5)

2.1.3.2 Excursus: Metadata and Controlled Vocabularies

Metadata

Metadata, usually referred to as “data about data” (Shilakes & Tylman, 1998, p. 44; see also Hillmann, 2001; Wyllys, 2000a; Hlava, 2002.), can be defined more precisely as “definitional data that provides information about or documentation of other data managed within an application or environment” (Dictionary.com, 2004, keyword: metadata).

Metadata has been used ever “since the first librarian made a list of the items on a shelf of handwritten scrolls” (Hillmann, 2001, ¶ 1): traditional librarians commonly employ the so-called “big 3” (Author, Title, Subject) metadata elements to catalog the library’s stock of books and other media (Samantha Bailey, interviewed in Wodtke, 2002a; Wyllys, 2000a). Broad interest in the concepts of metadata arose with the increase in electronic publishing and digital libraries, and the associated problem of information overload (see 2.3.5.2) due to the huge amount of unstructured data available on the web (Hillmann, 2001).³⁰ Metadata can be classified as:

- Descriptive: data that describes the object (e.g. title, subject, audience)
- Intrinsic: data that can be extracted directly from an object (e.g. file name, size)
- Administrative: data used to manage the object (e.g. author, date to be reviewed)

Obviously, these classes are neither exhaustive, nor mutually exclusive: for example, the metadata “author of the resource” can be both descriptive and administrative (Rosenfeld & Morville, 2002; Wodtke, 2002; Samantha Bailey, interviewed in Wodtke, 2002a).

Metadata can be used for administrative purposes, e.g., identifying outdated content, as well as for retrieving purposes: a metadata “author” might be scanned by a website’s search engine to limit results to a specific author. By implementing Content Management software (see 2.2.7.1), metadata can also be employed to develop dynamically navigation systems (Rosenfeld & Morville, 2002; Samantha Bailey, interviewed in Wodtke, 2002a; Lider & Mo-soiu, 2003). In current research on turning the web into a *semantic web* (see 2.3.2.3), metadata is employed to add semantic relationships to unstructured web data, in order to improve automated processing of and thereby end users’ access to information (Fensel, 2003).

³⁰ To alleviate this problem, a worldwide movement, called the Dublin Core Metadata Initiative, works on standards for metadata on the web (see <http://dublincore.org> for more).

Controlled Vocabularies

Controlled vocabularies can be defined as “organized lists of words and phrases, or notation systems, that are used to initially tag content, and then to find it through navigation or search” (Warner, 2002, ¶ 2). Controlled vocabularies are used in an IA system in:

- the navigation system, to consistently label navigational elements
- the metadata schema, to assign adequate attribute values to content objects
- the search system, to provide extended search functionality (e.g., synonym expansion)

(Rosenfeld & Morville, 2002; Warner, 2002; Samantha Bailey, interviewed in Wodtke, 2002a)

Controlled vocabularies vary in the amount of relationships defined between individual terms. From fewest to most relationships, the basic types are (1) synonym ring, (2) authority file, (3) taxonomy, and (4) thesaurus (Fast, Leise, & Steckel, 2002; Rosenfeld & Morville, 2002).

(1) A *synonym ring* identifies equivalence relationships between terms for search purposes. Thus, a search for “dungarees” on a clothing retailers’ website would be treated by the search engine as identical to searching for “jeans”, and therefore return all documents including either one or both terms (Fast et al., 2002). Similarly, a misspelled search could be directed to include the results for the correct spelling (Rosenfeld & Morville, 2002).

(2) An *authority file* also specifies equivalence relationships, but identifies one preferred term within the synonyms, so that “jeans” is preferred to “dungarees”. The list of preferred terms can then support content providers in consistent and efficient indexing³¹. Preferred terms (or correct spellings) might also be shown in the search results page to reinforce the use of correct terms (Fast, Leise, & Steckel, 2003; Samantha Bailey, interviewed in Wodtke, 2002a).

(3) A *taxonomy*³² defines hierarchical in addition to equivalence relationships between terms. The resulting hierarchy of preferred terms (see Figure 2-6) can be used as a browsable menu structure (as in www.yahoo.com), or as a back-end tool used by content providers for organizing and indexing documents (Rosenfeld & Morville, 2002).

(4) A *thesaurus* identifies associative relationships between terms in addition to equivalence and hierarchical relationships. Thus, the term “cracker” becomes linked to the related term “cheese” (Hagedorn, 2001; see Figure 2-6). Similar to a taxonomy, a thesaurus can also be used for searching and indexing purposes, but with much more semantic power and flexibility (Samantha Bailey, interviewed in Wodtke, 2002a; Rosenfeld & Morville, 2002).

³¹ Indexing: assignment of metadata attribute values to content objects

³² Sometimes a taxonomy is also referred to as “classification system” (Rosenfeld & Morville, 2002)

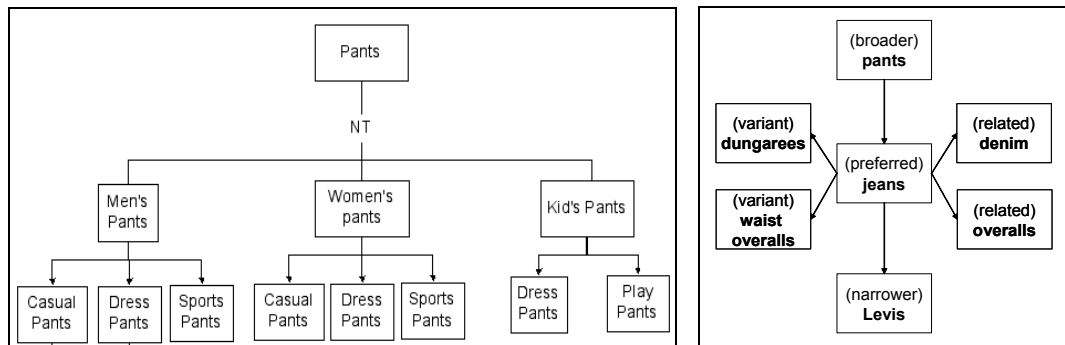


Figure 2-6: A taxonomy for the concept “pants” (left; Fast et al., 2002) and relationships between respective thesaurus terms (right; adapted from Hagedorn, 2001)

Despite their numerous benefits, controlled vocabularies “are not the magic pill that will cure what ails your site” (Fast et al., 2002, ¶ 31). The potential shortcomings of implementing controlled vocabularies and underlying metadata schemata include:

- Both are labor-intensive to develop, and difficult and time consuming to maintain
- They put additional workload on content providers to manually index their content
- Manually created metadata is prone to low quality
- Both can be very political

(Rosenfeld, 1998; Doctorow, 2001; Baker, 2002; Fast et al., 2002; Rosenfeld & Morville, 2002)

2.1.3.3 Conclusion on Components of an Information Architecture System

The discussion about what components constitute an IA system are reflective of the conflicting definitions of “Interaction IA” vs. “Library IA”: Proponents of the latter typically confine IA systems to include structural, rather abstract organization and labeling of information, as well as navigation and search mechanisms, with an emphasis on librarians’ tools like metadata and controlled vocabularies (e.g., Rosenfeld & Morville, 1998; 2002; Wyllys, 2000). Proponents of the former, however, also incorporate tangible, screen-level information organization and design, and the design of interaction flows (e.g., Vodvarka, 2000; Wodtke, 2002; Reiss, 2000). Only recently, attempts are made to merge the differing views. Forsman’s (2003) holistic approach to describing IA components can be seen as a first major step into that direction. This rather broad view serves as a starting point for the present thesis, if however, a separate IA system model will be devised later on.

2.1.4 The Process of Information Architecture

2.1.4.1 Basic Top-Down Information Architecture Process

Information Architecture processes can be classified according to their approach in organizing information as “bottom-up” or “top-down” processes. Top-down processes, as outlined in Table 2-1, emphasize the need to first understand user and business needs, and build the IA system according to users’ conceptual models of the information space. Starting at the most generic level, organization systems, as well as screen-level information organization and other IA system components are then gradually refined, e.g., by breaking down broad categories of content and functionality into more and more detailed sub-categories. (Hagedorn, 2000; Fox, 2002; Fraser, 2002a; Myer, 2002; Garrett, 2002a). Figure 2-7 shows an exemplary basic top-down IA process, which comprises phases 1 through 4 of the basic top-down IA process.³³

Table 2-1: Basic top-down Information Architecture process

Basic top-down Information Architecture process	
1. Discovery	
a.	Specify the organization’s business and brand strategy
b.	Identify focus, goals, and target audience of the website
c.	Develop a project plan (including scope, objectives, strategy, timing, and costs of the project)
2. Analysis	
a.	Perform user research
	▪ Analyze users’ tasks, needs, information seeking behaviors, experiences, vocabularies
	▪ Gather content and functional requirements
b.	Analyze content / site; competitive analysis
	▪ Assess available and to-be developed content
	▪ Identify the site’s and competitors’ existing organization, labeling, navigation, and search systems
3. Design	
a.	Organize content on an inter-page level
b.	Label the content groupings
c.	Organize content on an intra-page level
d.	Define navigation & search systems
4. Evaluation & Documentation	
a.	(Usability) test and revise the IA system design
b.	Develop IA style guide and functional specifications
5. Implementation	
a.	Accompany technical implementation of the IA system
b.	Fine-tune IA system design

Note. Sources: Info.Design Inc. (2002); O’Donnell (2002); Ramsey (2002); Shiple (1998); West (1999); Zaudhaus LCC (2003).

³³ While in the following, some of the exemplary process descriptions originally also pay attention to the methods that can be applied in single process steps, here the focus is on *what* questions are addressed in single process steps rather than *how* they are answered; selected methods, then, are introduced in Chapters 2.1.5 and 2.2.6.1. Consequently, the outline of different IA processes in the following is meant to show basic activities performed in IA processes and their rough succession, but does not account for detailed process flows. For further details on the exemplary process descriptions, please see the referenced sources.

4. Documentation: communicating design	<ul style="list-style-type: none"> ▪ Create style guides and functional specifications ▪ Review of specifications and creative review
3. Design: developing structure/interaction	<ul style="list-style-type: none"> ▪ Create design concept, document it in a creative brief ▪ Design high-level [inter-page level] content structure ▪ Structure content & interaction at the user-visible [intra-page] level ▪ Prototype & test the design
2. Discovery: defining scope/requirements	<ul style="list-style-type: none"> ▪ Define project goals; perform competitive analysis ▪ Analyze users (work environment, tasks, content usage, info needs), client (brand & business objectives), and knowledge domain (terminology, standards, processes, general culture).
1. Pre-project: acquiring, estimating work	<ul style="list-style-type: none"> ▪ Evaluate / develop proposals, preach usability ▪ Develop work estimates

Figure 2-7: Exemplary basic top-down IA process: phases (left) and activities (right; Ramsey, 2002)

IA processes, in general, as well as other website development process descriptions, suffer from deficiencies typical for virtually any design process; thus, in practice, many of them:

- are inadequate for a given project in terms of scope, required resources, or roles
- are not sufficiently adjustable to these constraints of a given project
- as a result, deliver ineffective and inefficient process instances

(Garrett, 2002a; Rosenfeld & Morville, 2002; Wodtke, 2002)

Specifically for basic top-down process descriptions, while many of them account for both business and user needs in developing IA systems, they frequently fall short of sufficiently describing the balancing and resolving of conflicts between the two poles. In the majority of cases, this is due to their limited scope which for example does not explicitly and sufficiently align the user-centered IA process with Business Strategy (West, 1999; Zaudhaus LCC, 2003), Visual Design (Info.Design Inc., 2002; O'Donnell, 2003), or Corporate Branding issues (Info.Design Inc., 2002; O'Donnell, 2003; Shiple, 1998; West, 1999).

Most of these basic top-down IA process descriptions also do not come with an adequate description of how to select, apply, and integrate different methods within the overall process (Info.Design Inc., 2002; O'Donnell, 2003; West, 1999); while to skilled information architects, this might be compensated for by experience and other available literature, it nevertheless limits the accessibility of the process description for novice information architects, and in general the ease with which the process model can be implemented and tailored to specific project constraints.

2.1.4.2 Basic Integrated IA Process (Top-Down & Bottom-Up IA Combined)

In contrast to the previous *user*-centered top-down approach, bottom-up processes are fairly *content*-centered in that they focus on the “structure inherent in content” (Rosenfeld & Morville, 2002 p. 44; see also Fraser, 2002a). Starting at the most detailed level, single content elements are classified by defining their attributes and attribute values, and subsequently are organized into more and more generic categories. (Hagedorn, 2000; Garrett, 2002a; Lou Rosenfeld, interviewed in Hill, 2000). As a result, bottom-up processes put an emphasis on “metadata and all the things that involve metadata: what it should do, where it should be stored, how to deploy it, and how the different metadata interact” (Myer, 2002, ¶ 20). As the implementation of metadata schemata can involve substantial effort (see 2.1.3.2), bottom-up approaches can be very labor-intensive and therefore expensive (Rosenfeld, 1998).

Maybe due to the fact that bottom-up IA is still relatively new (Rosenfeld & Morville, 2002), maybe because it tends to involve technical details some information architects are a little uncomfortable with (e.g., data modeling, database / system development, etc.), the literature on IA processes mainly covers top-down approaches; bottom-up processes, while clearly on the rise (Merholz, 2001a; see also Peter Morville, interviewed in Olsen, 2002), are consistently described only in combination with top-down process elements. Combining both approaches results in an integrated IA process, which can be summarized as shown in Table 2-2.

Table 2-2: Basic integrated (combining top-down and bottom-up IA) IA process

Basic integrated (combining top-down and bottom-up approaches) Information Architecture process			
1. Discovery			
a. Specify the organization’s business and brand strategy			
b. Identify focus, goals, and target audience of the website			
c. Develop a project plan (including scope, objectives, strategy, timing, and costs of the project)			
2. Analysis			
Top-down analysis:		Bottom-up analysis:	
a. Perform user research			
▪ Analyze users’ tasks, needs, information seeking behaviors, experiences, vocabularies			
▪ Gather content and functional requirements			
b. Analyze content / site; competitive analysis			
▪ Assess available and to-be developed content			
▪ Identify the site’s and competitors’ existing organization, labeling, navigation, and search systems			
		▪ <i>Identify existing content type classes, metadata systems and controlled vocabularies</i>	
		▪ <i>Collect available metadata values for content objects</i>	
3. Design			
Top-down design:		Bottom-up design:	
a. Organize content on an inter-page level		b. <i>Define content type classes</i>	
c. Label the content groupings		d. <i>Design metadata schemata and controlled vocabularies</i>	
e. Organize content on an intra-page level			

f. Define navigation & search systems
4. Evaluation & Documentation
a. (Usability) test and revise the IA system design
b. Develop IA style guide and functional specifications
5. Implementation
a. Accompany technical implementation of the IA system
b. Fine-tune IA system design

Notes. Sources: Morrogh, 2003; Rosenfeld & Morville, 2002; Svec, 2000; Veen & Fraser, 2001. Phrases in italics represent changes / additional process steps compared to the basic top-down IA process presented in Table 2-1.

As an example for integrated IA processes, Adaptivepath, a San Francisco-based user experience consultancy, adopts an approach explicitly balancing bottom-up and top-down elements (see Figure 2-8). The model breaks the basic integrated IA process down into eight distinct process steps (see Table 2-3).

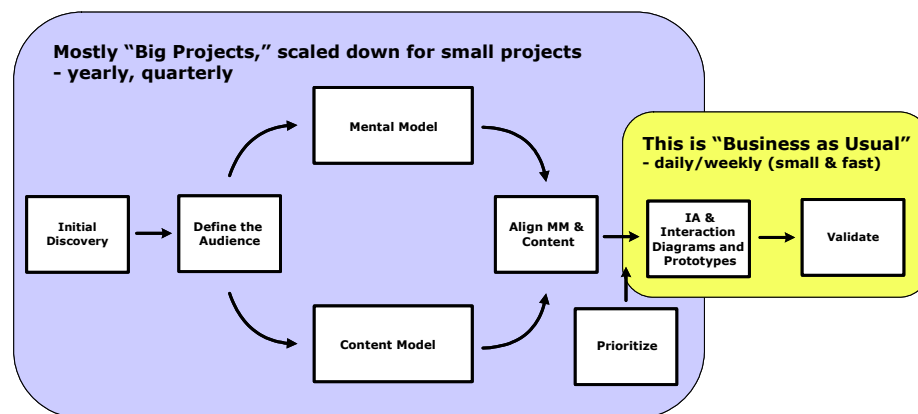


Figure 2-8: Exemplary basic integrated IA process:
Adaptivepath's IA process overview (Veen & Fraser, 2001)

Table 2-3: Exemplary basic integrated IA process: Adaptivepath's IA process phases

Phase	Major goals and activities
Initial Discovery	<ul style="list-style-type: none"> Define the project (e.g., stakeholders, project scope, and business mandate; resources, methods, process, schedule, budget)
Define the Audience	<ul style="list-style-type: none"> Define the target audience Identify audience subgroups and their priorities
Mental Model	<ul style="list-style-type: none"> Perform user task interviews Analyze interview task data Develop a mental model diagram (visualization of how users view workflows)
Content Model	<ul style="list-style-type: none"> Research current state of content, functionality, and the technology backing it Review competitor's websites, with an emphasis on functional implementations Develop a content model diagram (incl. metadata schemata and controlled vocabularies)
Align MM & Content	<ul style="list-style-type: none"> Assign content and functionality to a user's task it serves Identify gaps where either a task is not served by content / functionality, or content / functionality is available but no appropriate task
Prioritize	<ul style="list-style-type: none"> Identify the baseline of features necessary to launch and dependencies between features Ask stakeholders to rate importance (both to business and user) and technical feasibility If necessary, plan phased implementation of content and functionality
IA & Interaction Diagrams and Prototypes	<ul style="list-style-type: none"> Organize content on an inter- and intra-page level Define interaction flows Prototype the website
Validate	<ul style="list-style-type: none"> Test prototypes of the website against usability principles and goals

Note. Sources: Veen & Fraser, 2001; Fraser, 2002a; Fox, 2002.

While most integrated IA processes acknowledge the need to align the IA process with the technical infrastructure of the web-based information system (e.g., Rosenfeld & Morville, 2002; Veen & Fraser, 2001), none of the process descriptions covered here does explicitly describe how to align the IA process with the design of the underlying database, despite the close relationships and dependencies between bottom-up IA and Data Modeling (see 2.2.5).

In addition, although these IA process descriptions are supposed to also factor in bottom-up IA, respective bottom-up process steps and methods are only rarely described in detail³⁴, and as a result, the integration of bottom-up with top-down process elements has remained fragmentary until now; none of the available IA process descriptions explicitly addresses how respective process steps and methods of the two approaches depend on each other within the overall IA process in terms of temporal succession and flow of input/output.

2.1.4.3 IA Incorporated in a User-Centered Website Development Process

While the previous process descriptions more or less exclusively focus on the design of the IA system of a website, the overall picture of website development is of course more complex. To locate IA system design within the overall process for developing websites, Table 2-4 presents a basic user-centered website development process, which incorporates IA system design activities at various stages of the process.

Table 2-4: IA incorporated in a basic user-centered website development process

Basic user-centered website development process				
1. Discovery				
a. Specify the organization's business and brand strategy				
b. Identify focus, goals, and target audience of the website				
c. Develop a project plan (including scope, objectives, strategy, timing, and costs of the project)				
2. Analysis				
a. Perform user research				
▪ Analyze users' tasks, needs, information seeking behaviors, experiences, vocabularies				
▪ Gather content and functional requirements				
b. Analyze content, site, and the organization; competitive analysis				
▪ Assess available and to-be developed content				
▪ Identify the site's and competitors' existing IA systems, <i>functionality</i> , and <i>visual design</i>				
▪ <i>Specify organizational stakeholders and processes</i>				
3. Design & Evaluation				
Inter-page level design:	Intra-page level design:	Content design:	Hard- & software design:	
a. Organize content on an inter-page level	b. Organize content on an intra-page level	c. <i>Design content</i> (incl. metadata)	d. Design hardware and software architecture	
e. Label content groupings	f. Define navigation & search systems	g. <i>Plan/manage content creation</i>		

³⁴ For example, Rosenfeld & Morville, 2002, explain in detail controlled vocabularies, but not their actual creation; Veen & Fraser, 2001, describe the development of a content model, but do not explicitly address metadata / controlled vocabulary design.

h. <i>Define interaction flows & error handling</i>	i. <i>Define interface elements</i>		
	j. <i>Develop visual design</i>		
k. (Usability) test and revise the design			
4. Implementation			
a. <i>Set up hardware, code the software architecture: design, implement, and test functionality</i>			
b. <i>Create content</i>			
c. <i>Plan deployment and marketing campaigns</i>			
5. Deployment			
a. <i>Perform final testing</i>			
b. <i>Run marketing campaigns</i>			
c. <i>Go live with website</i>			
6. Maintenance			
a. <i>Monitor and evaluate the live site</i>			
b. <i>Fine-tune the site for optimum performance and results</i>			

Notes. Sources: Burdman, 1999; Dijck, 2002; Garrett, 2002a; IconMedialab International AB, 2002; Marshak, 2004; Reiss, 2000; Vora, 1998. Phrases in italics represent additional process steps compared to the basic integrated IA process presented in Table 2-2.

As an example, the IconProcess (IconMedialab International AB, 2002; Marshak, 2004) provides a holistic description of the overall website development process. Information architecture activities are performed as part of an overall User Experience workflow (see Figure 2-9, right diagram; Table 2-5), which in turn is one of nine disciplines involved (represented row-wise in the left diagram of Figure 2-9).

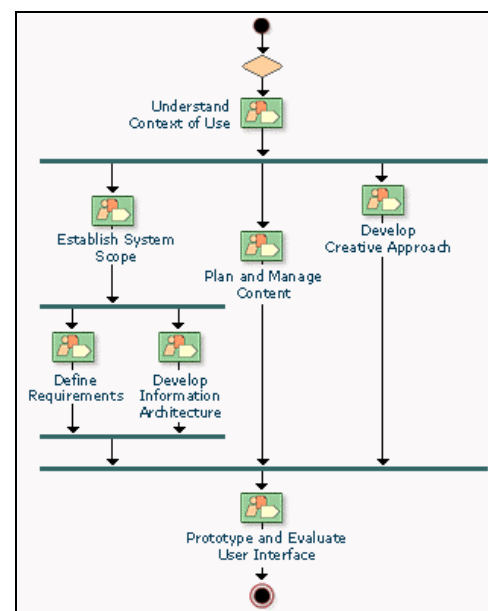
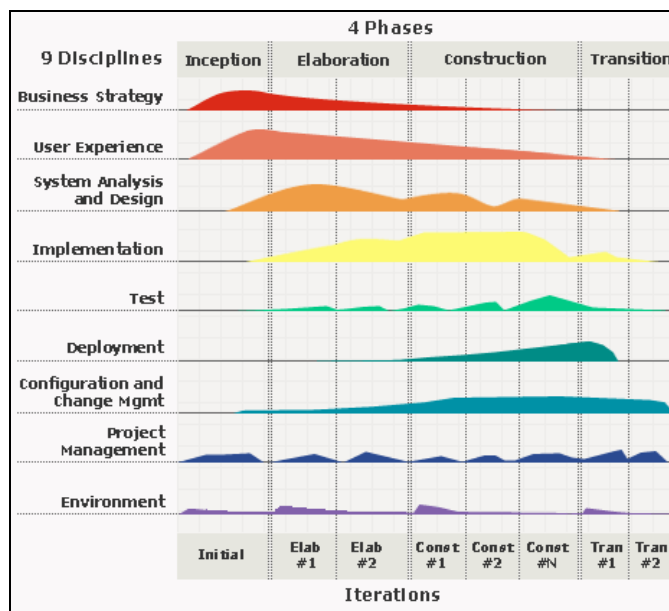


Figure 2-9: Exemplary process incorporating IA in a user-centered website development process: Icon-Process overview (left) and user experience workflow (right) (Marshak, 2004)

Although most of these website development process descriptions also cover the design and creation of content (e.g., Marshak, 2004, in “Plan and Manage Content”; see Figure 2-9), hardly any of them describes in detail how dependencies between IA and Content Manage-

ment processes (see 2.2.7) translate into a coherent site design process.³⁵ Although especially bottom-up IA deliverables such as metadata schemata and controlled vocabularies are regularly employed by content providers (see 2.1.3.2), all of them fall short of accounting for needs of content providers regarding these IA system components, as well as at assessing whether the content-related aspects of the IA system can actually be realized by them.³⁶

Table 2-5: Exemplary process incorporating IA in a user-centered website development process: IconProcess' user experience workflow (Marshak, 2004)

User experience workflow step	Major goals and activities
Understand Context of Use	<ul style="list-style-type: none"> ▪ Profile target users ▪ Research potential user needs
Establish System Scope	<ul style="list-style-type: none"> ▪ Find actors and use cases (including identifying system interfaces) ▪ Define system-wide attributes ▪ Manage dependencies
Define Requirements	<ul style="list-style-type: none"> ▪ Detail a use case ▪ Structure the use case model ▪ Manage dependencies
Develop Information Architecture	<ul style="list-style-type: none"> ▪ Organize information and navigation mechanisms: design site maps, URLs, and pages or page-templates
Plan and Manage Content	<ul style="list-style-type: none"> ▪ Assess content: evaluate existing content and address content sourcing issues ▪ Formalize content development guide: define how business, marketing, and brand strategy decisions are reflected in the content's editorial voice and tone
Develop Creative Approach	<ul style="list-style-type: none"> ▪ Define key experiences and develop visual system ▪ Draft the creative concept including key experiences and initial visual design elements ▪ Formalize visual development guidelines: transform creative concept into concrete decisions and guidelines
Prototype and Evaluate User Interface	<ul style="list-style-type: none"> ▪ Plan usability test ▪ Conduct usability test

Most of these website development processes adopt an interdisciplinary approach (e.g., Marshak, 2004, explicitly describes nine distinct disciplines involved in the IconProcess); however, for many of them, descriptions of individual responsibilities and of the interaction between those disciplines, e.g., the flow of input between them, remain high-level, which impedes efficient interdisciplinary collaboration in practice (e.g., Dijck, 2002; Reiss, 2000; Vora, 1998).

³⁵ For example, Garrett (2002a) addresses defining fundamental formal content requirements like content size and format, and basic content management issues, like responsibilities and update frequency (which is also accounted for by Vora, 1998).

³⁶ Reiss (2000) suggests introducing content providers to an IA system before implementation; however, no evaluation or revision of the IA system is included.

2.1.4.4 Conclusion on IA Processes

IA processes, just like IA components, are also reflective of the process' underlying definition of IA: bottom-up approaches emphasize classifying content elements with respect to selected attributes and grouping content according to the respective attribute values, and thus are more in line with the content-centered Library IA approach. While bottom-up IA approaches have a potential to bridge the gap of implementation by closely resembling Data Modeling deliverables (see 2.2.5), this is not fully leveraged in the available process descriptions.

Top-down IA processes, on the other hand, focus on the “big picture” (Myer, 2002, ¶ 18), by translating user and business needs into an IA system. Frequently, this also covers screen-level information organization and interaction flow design. This broadened scope on IA deliverables, together with the user-centered approach, comes along with the “Interaction IA” definition. However, the growing complexity of information systems and the need for holistic solutions, call for a comprehensive alignment of these two approaches in the future.

2.1.5 Methods and Deliverables of Information Architecture

2.1.5.1 Introduction

A large part of the numerous methods applied in IA processes, especially in top-down IA processes, was originally developed or refined in traditional user-centered design disciplines, e.g., in Usability Engineering.³⁷ While general user-centered design methods are introduced in detail in 2.2.6.1, in the following, two methods are described which are typical for the design of IA systems: card sorting and content inventory. Characteristic deliverables of IA practice include blueprints, wireframes, metadata schemata, and controlled vocabularies (Alison J. Head, interviewed in Rhodes, 2001b; Rosenfeld & Morville, 2002; Wodtke, 2002). While the latter two are described in 2.1.3.2, the former are introduced in this chapter.

2.1.5.2 Card Sorting

Card sorting is a data collection method most frequently applied within user-centered approaches to taxonomy development, in order to identify users' perceptions of relationships between content elements in terms of:

- the degree of similarity of elements within a category

³⁷ For comprehensive overviews on IA methods, see for example Wodtke, 2002; Reiss, 2000; Rosenfeld & Morville, 2002.

- the degree of overlap between categories
- how well a child content element represents its parent

(Nielsen & Sano, 1994; Kanerva, Keeker, Ridsen, Schuh, & Czerwinski, 1998; Martin, 1999; Toub, 2000)

The overall goal of card sorting, thus, is to construct or validate a taxonomy reflective of their conceptual representations (see 2.1.2.5). Card sorting exercises can be conducted in a number of settings, e.g. one-on-one, in a group setting, during workshops, or even via mail or electronically (Gaffney, 2000b). While *open* card sorts let users create their own categories, in *closed* card sorts, predefined categories are employed. Thus, closed sorts might be used to evaluate groups that evolved from exploratory open sorts (Toub, 2000). The basic procedure, however, is nearly the same for both types; steps include:

1. Gather content items.
2. Write label on a index card for each item.
3. Define target audience to test with.
4. Present cards to users in random order.
5. Ask users to:
 - a. place each card into one of a set of pre-defined categories (closed card sort) or
 - b. group cards and label the groups with category labels (open card sort).
6. Ask users either to merge groups or further subdivide groups (if necessary).
7. Document and analyze the resulting data.

(Nielsen & Sano, 1994; Martin, 1999; Toub, 2000; Robertson, 2002; Gaffney, 2000b)

Data analysis can be performed qualitatively (e.g., “eyeballing” the results; Nielsen & Sano, 1994) as well as quantitatively, which relies on statistical techniques such as similarity matrices, cluster analysis, or multidimensional scaling. In any case, the basic idea is to combine the data of several participants to arrive at a user-based conceptualization of the content structure (Nielsen & Sano, 1994; Fuccella & Pizzolato, 1999a; Martin, 1999).

In practice, card-sorting exercises provide a number of benefits. They are cheap, effective, simple, well understood by participants, and quick, which allows more users to be involved (Robertson, 2002; Gaffney, 2000b; Toub, 2000). In addition, card sort exercises avoid the pitfalls found in many techniques involving directly questioning respondents (Robertson, 2002; see 2.2.6.1). They also are well suited for identifying labels that might be misunderstood or items that might be hard to find, and differences between novice and expert users’ conceptual models (Nielsen & Sano, 1994; Gaffney, 2000b). However, the conceptual models

of users do not always reflect the optimal solution, as they do not account for business requirements, strategic directions, technical limitations, and usability guidelines, and labels given by users vary on a broad scale (Nielsen & Sano, 1994; Robertson, 2002).

There are many variations to the basic procedure, e.g., asking users to add missing items to a group, to identify which terms are not easily understood and make suggestions for improvement, to discard unimportant items, to duplicate items in a second group, or to sort items according to the value they attach to it for prioritizing features (Cunliffe et al., 2002; Gaffney, 2000b; Kuniavsky, 2003a). Further variants of the basic method include:

- **Category Description:** users are presented a label, and asked to describe the information contained in this category (Fuccella & Pizzolato, 1999a)
- **Category Labeling:** users are presented several possible labels for a category together with sample items, and are asked to choose the appropriate label (Fuccella & Pizzolato, 1999a)

2.1.5.3 Content Inventory

Content inventories have been described as “a methodical review of a Website's content” (Fraser, 2001, ¶ 9). They are most frequently employed in redesign projects for content-centric websites to document what content is already available to be re-organized, and to analyze the actual state of organization systems (Bailey, 1997; Fraser, 2001; Wodtke, 2002). But they are also used to list to-be-developed or to-be-reviewed content elements, in order to allow for realistic project planning, assignment of responsibilities, and status tracking (Bailey, 1997; Rosenfeld & Morville, 2002; Wodtke, 2002). Basic types of content inventories include:

- *Content survey*: high-level review of major content areas to understand the scope and nature of existing content; thus typically performed at the beginning of an IA project.
- *Content audit*: detailed and comprehensive, page-by-page inventory of a website's content; supports the development of metadata schemata or the migration of content to a content management system.
- *Content map*: visual illustration of major content areas, typically reflecting the “big picture” in terms of important user and/or business objectives; can be derived from survey or audit.

(Fraser; 2001, Fox, 2002; Wodtke, 2002)

For both survey and audit, the basic procedure is the same: “clicking through your Website and recording what you find” (Veen, 2002a, ¶ 2) in an accurate, consistent, and thorough manner. To document findings, usually a spreadsheet is used that lists for each content element:

- Identification data (e.g., link ID; link name; link URL)
- Content data (e.g., content type class; document type class; topics/keywords)
- Management data (e.g., author/owner; status [existing/planned/wish-listed])³⁸
- Additional notes

(See Figure 2-10; Fraser, 2001; Veen, 2002a; Fox, 2002; Bailey, 1997)

Link ID	Link Name/Page Title	Link URL	Subject Type (not summary or keywords)	Document Type
1.0.0	about Client		marketing	info box
1.1.0	our offices	http://www.mysite.com/ex	nav	
1.2.0	Client at a glance	http://www.mysite.com/ex	nav	
1.2.1	corporate backgrounder	http://www.mysite.com/ex	marketing	paragraphs
1.2.2	awards	http://www.mysite.com/ex	marketing	list w/description
1.2.3	corporate history	http://www.mysite.com/ex	marketing	list w/description
1.2.4	corporate reports	http://www.mysite.com/ex	nav	
1.3.0	community connection	http://www.mysite.com/ex	nav	
1.3.1	charitable contributions	http://www.mysite.com/ex	marketing	paragraphs
1.3.2.0	volunteering to make a difference	http://www.mysite.com/ex	marketing	paragraphs
1.3.2.1	volunteer request form	http://www.mysite.com/ex	marketing	form
1.3.3	giving guidelines	http://www.mysite.com/ex	marketing	paragraphs
1.3.4	proposal process	http://www.mysite.com/ex	marketing	paragraphs
1.3.5	computer product contributions	http://www.mysite.com/ex	marketing	paragraphs

Figure 2-10: A sample content inventory spreadsheet (Fox, 2002)

To develop a content map, major content components found in the survey or audit are arranged according to user and / or business goals (e.g., with card sorting; Bailey, 1997), and documented using software like Visio or Photoshop (Fox, 2002; Fraser, 2001).

Although conducting a content inventory can be semi-automated (using a web crawler that collects the URLs on any given website), at its core it is a “decidedly human task” (Veen, 2002a, ¶ 13) of analyzing the information contained on a page. Depending on the size of the website to be analyzed, this can therefore be a tedious and time-consuming process (Wodtke, 2002; Jesse J. Garrett, interviewed in Evans, 2002; Veen 2002a). However, performing a content inventory returns a detailed understanding of a website’s content, which guides and supports the entire IA process (Fraser, 2001; Wodtke, 2002; Evans, 2002).

³⁸ Additional examples for management data include: user type (=intended audience); company type (customer, partner,...); facets; frequency of update; ROT flag (Redundant, Outdated, or Trivial content)

2.1.5.4 Wireframes

A wireframe can be defined as a basic, architectural outline of an individual page, indicating the elements of the page, their grouping and relationships, and their relative importance. Wireframes thus can be viewed as structural, medium fidelity prototypes of individual pages (see 2.2.6.1; Farnum, 2002; Gordon, 2002; Rosenfeld & Morville, 2002; Stanford, 2003).³⁹ As such, they are useful for conveying navigation, content, and structural requirements to clients, developers, visual designers, and content providers (Saffer, 2003; Doss, 2002), but can also be applied in usability testing (see 2.2.6.1; Reiss, 2000; Fuccella & Pizzolato, 1999).

Wireframes, just like other prototype variants (see 2.2.6.1), can be classified according to their level of fidelity (Rosenfeld & Morville, 2002; see Figure 2-11): while low-fidelity wireframes typically do not include graphical elements at all, high-fidelity wireframes may present a close approximation of the final page. High-fidelity wireframes are very good for communicating to clients and colleagues, and force the information architect to acknowledge the constraints of the medium. However, they are also more time-consuming to produce and hold the risk of shifting focus to interface design too early (Rosenfeld & Morville, 2002).

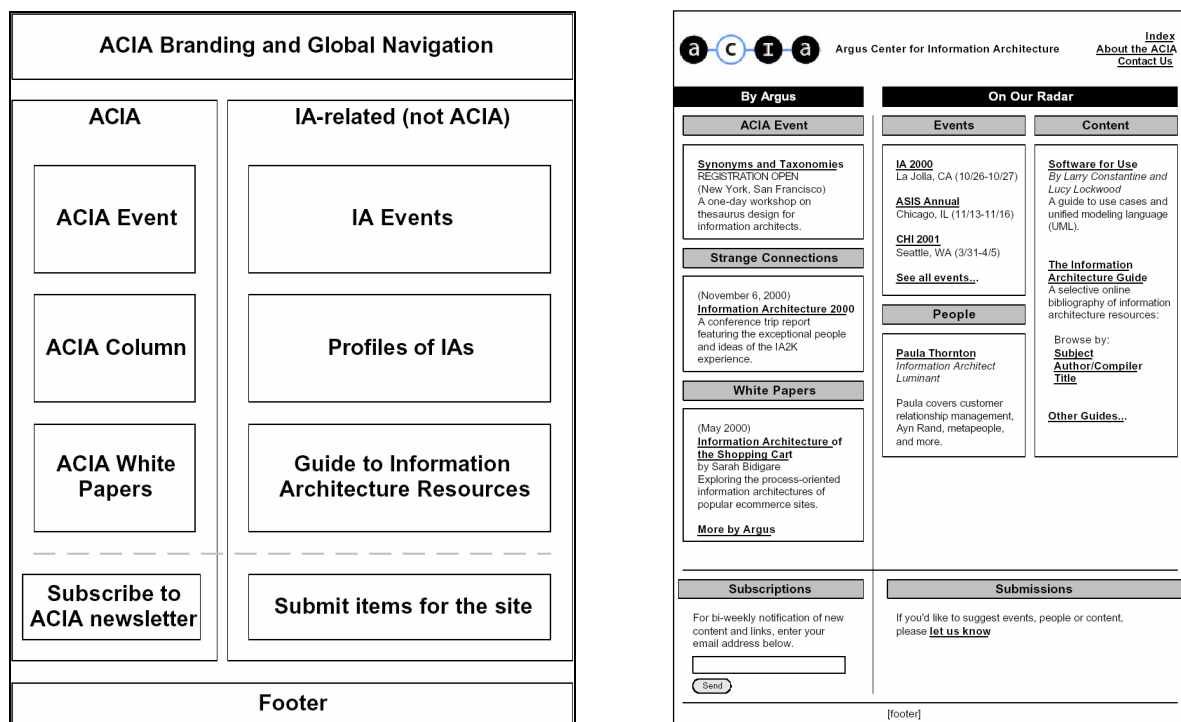


Figure 2-11: Lower- (left) and higher-fidelity (right) wireframes (Toub, 2000, pp. 11-12) (for the website of Argus' ACIA: www.argus-acia.com)

³⁹ Wireframes are sometimes also called page schematics or page architecture diagrams (e.g., Boogards, 2001; Wodke, 2001)

In order to be self-explanatory, a wireframe has to be annotated to explain details of each page element, its behavior, and the underlying rationale (Wodtke, 2002; Saffer, 2003). Depending on the particular audience, annotations serve additional functions, e.g., communicating system requirements to developers, content requirements to content providers, and business goal integration to clients (Saffer, 2003). While those audiences might be pleased by detailed specifications, designers might feel dictated to if the wireframe is too specific about graphic and visual design; however, if it is too imprecise, the wireframe might be misunderstood. Wireframes, therefore, “stand at the intersection of the site's information architecture and its visual and information design” (Rosenfeld & Morville, 2002, p. 283; see also Vodvarka, 2000), and thus are „probably the most controversial of the IA's deliverables” (Wodtke, 2001, ¶ 22).

To avoid these problems, a close collaboration and a clear division of responsibilities between designer and information architect should be fostered. The information architect might also create wireframes that don't dictate layout, such as for example Brown's “Page Description Diagram” (Brown, D., 2002), which is basically a textual description of the contents of a page, showing priority of content items by arranging them from left (most important) to right (least important; Brown, D., 2002; Lash, 2002; Rosenfeld & Morville, 2002; Wodtke, 2002).

The benefits of wireframes, whatever flavor they are, are multifold; wireframes can:

- effectively guide visual design efforts to prototype and include changes more quickly
- help to communicate the IA system to clients without them being distracted by visuals
- allow for quick and easy prototype testing with users, even with multiple versions
- serve as a checklist for content-gathering, -development and status tracking
- flesh out a singular vision for the site
- act as a starting point for developing text-only versions of the website

(Brown, D., 2002; Fuccella & Pizzolato, 1999)

There are however, also a number of downsides to using wireframes, including that they:

- might constrain visual designer's creativity and innovation
- draw clients' attention to layout details rather than information organization
- do not provide valid results when used in usability testing
- do not consider color, typography, and other brand identity elements
- focus IA efforts on layout, which is likely to be changed in later stages of the process
- are not necessarily ready to be implemented in HTML
- are not stand-alone deliverables of an IA specification

(Brown, D., 2002; Doss, 2002)

2.1.5.5 Blueprints

In the context of IA system development, blueprints are visual representations of the site structure, documenting the various pages or page types, their relationships, and user paths to and from them (Shiple, 1998; Wodke, 2001)⁴⁰. Major types of blueprints include:

- *Organization documentation*: content-oriented, documenting how static content is organized, labeled, and navigated (see Figure 2-12)
- *Interaction documentation*: task-oriented, documenting interaction flows and dynamic content organization (similar to task flow diagrams; see 2.2.2.2; Figure 2-15, Page 49) (Rosenfeld & Morville, 2002; Wodtke, 2002)

Blueprints, which resemble standard flowchart diagrams, vary in the level of detail they convey: while *high-level blueprints* map out the organization and labeling of major content areas of the website, *detailed blueprints* portray the entire website with its complete information hierarchy, labeling and navigation systems (Rosenfeld & Morville, 2002).

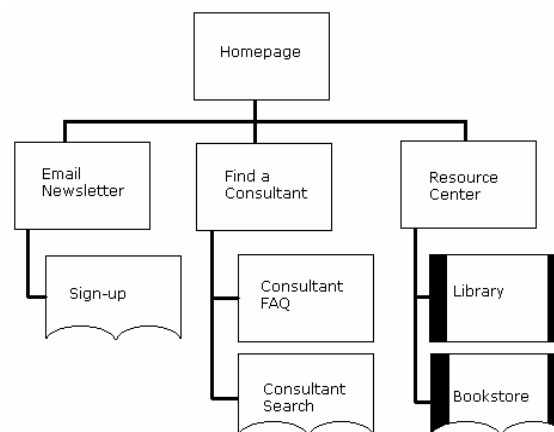


Figure 2-12: A simple high-level organization documentation blueprint (Shiple, 1998)

A blueprint is typically started early on in an IA project, and refined throughout, using first paper sketches, then software like MS Visio™. Standard flowchart and additional symbols, such as provided in Garrett (2002b), are used to represent pages, files, decision points, and other elements of a blueprint (Rosenfeld & Morville, 2002; Wodke, 2001; Wodtke, 2002).

⁴⁰ Blueprints are sometimes also referred to as “sitemaps” (e.g., Wodtke, 2002; Doss, 2002); however, the term “sitemap” is also used to describe a supplementary navigation system. Even if they are similar in that both portray a visual representation of how information is organized on a inter-page level, the term blueprint is used in the following to refer to the deliverable to avoid confusion, in line with Rosenfeld and Morville (1998; 2002), and Shiple (1998).

High-level blueprints are especially useful for communicating architectural approaches to clients and team members, to spark discussion and get buy-in. Detailed blueprints serve the production team to be able to implement the IA system without a need for constant physical presence of the information architect (Rosenfeld & Morville, 2002; Boleyn & Jetton, 2001). However, for very large websites, detailed blueprints can become inefficient, and organization documentation blueprints are not suited for portraying highly functional, non-static websites; the focus will shift here to interaction documentation blueprints (Boleyn & Jetton, 2001).

2.1.6 The Impact of Information Architecture

2.1.6.1 Introduction

In order to create successful IA systems, an information architect “must align the goals of the business with the goals of the users, and at the same time work within the constraints posed by the project [...], technical issues [...], and content production [...]” (Myer, 2002, ¶ 13). In return, IA process and deliverables also significantly affect these determinants of IA: (1) end users, (2) business performance, (3) System Development, and (4) Content Management.⁴¹

2.1.6.2 Impact on End Users of Information Systems

A high-quality IA system enhances user satisfaction and productivity as it can:

- support clear communication of purpose and context to users
- increase the chance for finding information
- reduce the cost of finding information (e.g., time; money)
- reduce the cost of not finding information at all
- reduce the cost of finding the wrong information (e.g., poor or faulty decisions)
- increase flexibility by allowing for easy switching between browsing and searching
- minimize task complexity and aid in successful task completion
- allow for role-based and fluid access to information and applications
- strengthen the user’s security and trust
- make using a website a more enjoyable experience
- facilitate successful interaction and collaboration between users

⁴¹ See also 2.2.6 on benefits of User-Centered Design approaches in general.

(Lou Rosenfeld, interviewed in Rhodes, 1999; Toub, 2000; Feldman & Sherman, 2001; Burke, 2002; Lash, 2002; Rosenfeld & Morville, 2002; Forsman, 2003)⁴²

2.1.6.3 Impact on Business Performance

Some of these benefits for users obviously and directly translate into monetary value for the sponsoring business, while the effect of others is somewhat unapparent, but still existing. The financial value of IA efforts is especially evident in the case of corporate intranets: an increase in employee satisfaction and productivity leads to cost savings for the organization. However, also when addressing customers, investors, or other people outside the organization, an effective IA system can:

- provide a competitive advantage
- increase sales
- increase users' product awareness
- support users' adequate representation of the site's content
- improve brand loyalty
- reduce the need for live sales
- improve already existing sales routines
- in general, improve relationships with customers, investor, and press

(Lou Rosenfeld, interviewed in Rhodes, 1999; Reiss, 2000; Toub, 2000; Lash, 2002; Rosenfeld & Morville, 2002; Forsman, 2003)

For both internal and external focus, developing a high-quality IA system can have additional positive effects:

- Reduction of construction costs
- Reduction of training, maintenance, and service costs
- Reduction of costs for printed documentation
- Reduction of staff turnover
- Reduction of organizational upheaval and "politicking"
- Improved knowledge sharing within the organization, reduction of duplicated effort
- Solidification of the underlying business strategy (see also 2.2.1)

(Reiss, 2000; Toub, 2000; Feldman & Sherman, 2001; Lash, 2002; Rosenfeld & Morville, 2002)⁴³

⁴² See also 2.3.2 for how web-specific deficiencies challenge the design of a website, and 2.3.5.2 for respective psychological consequence of these deficits on the user's side

2.1.6.4 Impact on Development of Information Systems

Deploying IA practices can improve the actual building of information systems as it:

- provides a structured and controlled development framework
- reduces duplication of effort
- allows for low-cost changes in early design stages
- enables efficient development efforts
- assists in choosing appropriate technology solutions
- allows for scalable and flexible solutions
- allows for natural, organic growth of networked information systems
- assists in tackling and seizing technological trends and challenges

(Reiss, 2000; Alison J. Head, interviewed in Rhodes, 2001b; Burke, 2002; Rosenfeld & Morville, 2002; Forsman, 2003)⁴⁴

2.1.6.5 Impact on Management of Content in Information Systems

Deploying IA practices improves the creation and management of content by:

- providing metadata schemata and controlled vocabularies for structured writing
- defining formal and semantic content requirements
- verifying the application of metadata (“tagging”)
- integrating new content and advancing the existing content model
- defining when to remove outdated content

(Lou Rosenfeld, interviewed in Rhodes, 1999; Reiss, 2000; Toub, 2000; Warren, 2001; Baker, 2002)⁴⁵

2.1.7 The Future of Information Architecture

The discipline of Information Architecture, as described in the previous chapters, “is a new field and still in a formative stage” (Morrogh, 2003, p. 163). While to many practitioners, this is an exciting opportunity and challenge, such a state of immaturity typically involves problems of acquiring recognition and credibility in the public, gaining market share, developing and refining processes and methods, and building up a communal infrastructure (see for example, Dillon, 2002; Garrett, 2002; Rosenfeld, 2002). Although in this respect,

⁴³ See also 2.3.5.3 for how web-specific deficiencies that users suffer from cause financial losses to the organization that owns the website, and a hypothetical return on IA investments calculation

⁴⁴ See also 2.2.5 for more on Database Design and System Development and the relationships with IA.

⁴⁵ For a detailed analysis of the relationship between IA and Content Management activities, see 2.2.7

Morville (2002, ¶ 19) believes IA to be at the verge of “entering a new stage of maturity”, many of these problems yet have to be resolved in the future, as outlined in the following.

Definition and Components of IA

As described in 2.1.2 and 2.1.3, IA definitions are abundant, as much as there is dissent about a final definition. Although some professionals refuse to take part in the seemingly unproductive effort of “defining the damn thing” (Wodtke, 2001a), there is an obvious need for concise definitions, in order to advance the discipline, sell IA to clients, and improve communication within professionals (Dillon, 2002; Garrett, 2002; Merholz, 2001; 2001a; see also 2.1.2.6 and 2.2.8). Even if Morville (2002, ¶ 19) contends that “a de facto definition of information architecture has [already] emerged and reached critical mass”, a consensus may require that “information architects will continue to struggle to define IA for many years to come” (Morrogh, 2003, p. 163; see also Rosenfeld, 2002).

Specialization vs. Generalization of IA Roles

In the future, some leaders of the field expect IA roles to evolve in focused experts and overall “IA directors”, similar to the “Webmaster”-role in the 1990s, which eventually became fractured as skills required and responsibilities given had grown exponentially (Merholz, 2001a⁴⁶; see also Lash, 2002). However, Garrett (2002; also Lash, 2002) warns that too much emphasis on specialization might counteract the progress of IA as a discipline, as the future of IA will largely depend on how much non-specialists can take over IA expertise and skills in their everyday practice.

Extending the Focus of IA Beyond the WWW

As mentioned in 2.1.2.1, current IA might focus on organizing websites, but in general, the concepts of IA can be easily translated to other information product domains. In the future, Arnold Lund (as cited in Morrogh, 2003, p. 160; see also Dillon, 2002; Samantha Bailey, interviewed in Wodtke, 2002a; Kalbach, 2003) predicts that Information Architecture will embrace “visual and audio experiences delivered over workstations, mobile devices, interactive broadband devices, and others and to experiences that span these devices”. For information architects, this implies the need to understand these different environments and their respective context of use, in order to be able to develop the required integrated and meta-level IA systems (Lilian Svec, Arnold Lund, Karyn Young, as cited in Morrogh, 2003).

⁴⁶ Reporting on an expert discussion panel on “the past, present, and future of information architecture” at the IA Summit 2001, San Francisco, CA (February 2-4).

Process and Methods of IA

In order to be able to manage future challenges, Lilian Svec (as cited in Morrogh, 2003) insists on continuing to evolve and invent IA methods as well as process models, especially to support collaborative work within teams of focused specialists, thereby drawing on and fully acknowledging its multidisciplinary heritage (see also Rosenfeld, 2002; Rosenfeld & Morville, 2002). This also involves resolving the conflicts between IA and other disciplines, especially Usability Engineering (see 2.2.6.3; Dillon, 2002; Garrett, 2002; Alison J. Head, as cited in Morrogh, 2003). Further IA process and methods issues include:

- Integrate analysis of server-log data showing user behavior in IA research methods
- Fully leverage bottom-up IA, aligning bottom-up with top-down IA processes
- Acknowledge that content quality is critical; devising methods to ensure useful content
- Evaluate & improve methods and deliverables, relying on a case-study approach
- Integrate approved IA principles in site development (e.g., content management) tools
- Develop tools to visualize information and IA deliverables

(Lou Rosenfeld, interviewed in Rhodes, 1999; Merholz, 2001, 2001a; Rosenfeld, 2001a; Wodtke, 2001a; Rosenfeld & Morville, 2002; Samantha Bailey, interviewed in Wodtke, 2002a; McGovern, Usborne, & Chak, 2003; Wixon, 2003)

Selling IA and Demonstrating Return on IA Investments

A discipline as young as IA typically suffers from lack of recognition and credibility in industry (Garrett, 2002), and thus, a major future challenge for IA in order to gain market share is to prove its value in terms of monetary return (Merholz, 2001a; Rhodes, 2002a; Rosenfeld & Morville, 2002; Samantha Bailey, interviewed in Wodtke, 2002a; Lilian Svec, as cited in Morrogh, 2003). However, although the benefits of IA efforts have been listed by several authors (see 2.1.6), calculating the return on IA investments poses inherent and, up to now, not sufficiently resolved problems (see 2.3.5.3).

Professional Affiliations and Qualification

A final issue in evolving IA as a discipline involves establishing a communal and educational infrastructure for IA practitioners and researchers. Initial steps in this direction have been taken, for example through publication of books, through conferences, journals, and the founding of a professional organization (see 2.1.1 on the history of Information Architecture). In addition, dedicated IA curriculums have been developed in several universities in the US (see for example Ewing et al., 2001). However, further establishing these cornerstones of a

legitimate discipline remain a major task for the future (Ewing et al., 2001; Merholz, 2001a; Dillon, 2002; Latham, 2002).

In the coming years, overall growth of information is expected to continue at an accelerated rate, involving an increase in scope, volume, and format types; alone in 2002, overall new information produced in print, film, magnetic, and optical storage devices worldwide is estimated to have amounted to about 5 exabytes⁴⁷ (Lyman & Varian, 2003; see also 2.3.2.1 on internet growth). Information and communication technology will more than likely be characterized by even more unanticipated technological breakthroughs, and the complexity of creating, disseminating, and using information will become even more difficult (Lou Rosenfeld, interviewed in Rhodes, 1999; Morville, 2002; Rosenfeld, 2002; Rosenfeld & Morville, 2002; Morrogh, 2003). While the capriciousness involved in the development of information and communication technology may make predicting the future of IA inherently difficult, it seems clear that the need for IA expertise will be even more pressing in the future. Thus, the number of practicing information architects is expected to grow, more training and education on IA will supposedly be offered, and organizations are likely to spend more resources on IA efforts (Morville, 2003⁴⁸).

As a discipline, Information Architecture started out as a “reaction to the demands and pressures caused by (...) the [revolutionary] advent of the Internet and its suite of related technologies” (Rosenfeld, 2002, p. 875; see also Chapter 1). In the future, however, it might transform the virtual world in a way that even excels the impact of traditional architecture on the physical world, or as Dillon (2002, p. 823) puts it, “those that will shape the new spaces [of information] will impact humankind on a level that will prove beyond the reach of physical architecture”.

⁴⁷ 1 exabyte = 10^{18} bytes.

⁴⁸ Reporting on a survey among IA practitioners on the future of IA, conducted in January 2003.

2.2 Related Disciplines in Website Development

As mentioned before, IA is rooted in many disciplines, Library & Information Science (LIS) and Human-Computer Interaction (HCI) being the most prominent (see 2.1.2). Similarly, IA also interacts with various other disciplines within the overall process of information system design and development. As this entire industry is a relatively new one, a huge number of terms is used to describe partly distinct, partly overlapping fields of expertise. Garrett (2000) provides an overview to disentangle this hodgepodge of terms (see Figure 2-13).

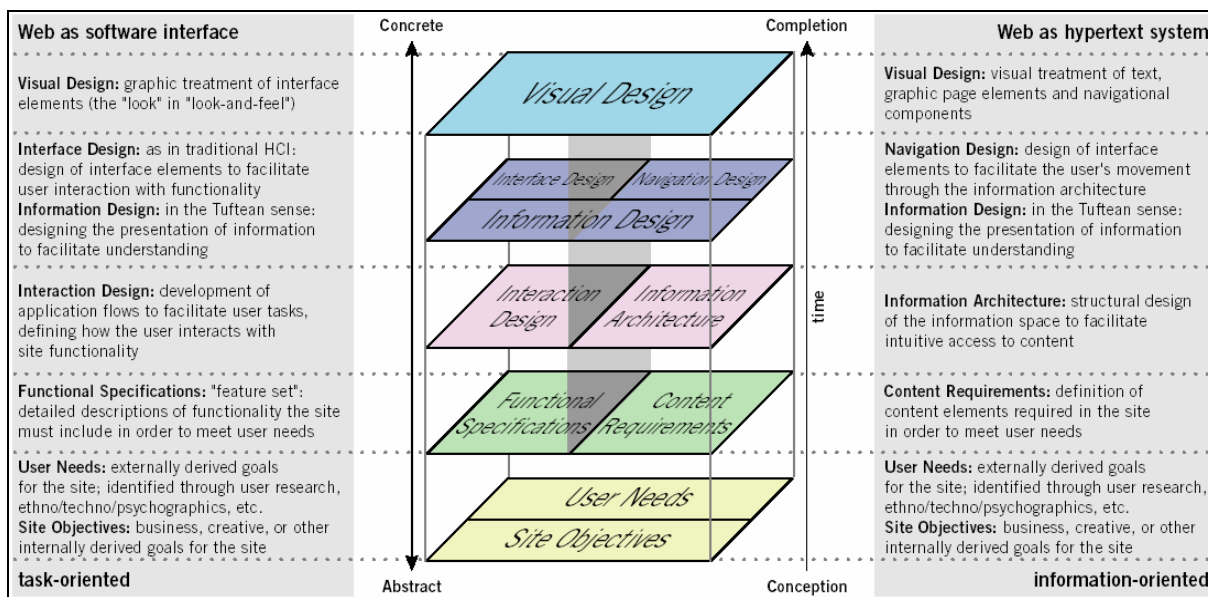


Figure 2-13: The elements of user experience (Garrett, 2000)

In the following, related disciplines of IA in information system development are introduced and the interrelations are identified. This description extends on Garrett's diagram; while the characterization of Interaction Design, Information Design, and Visual Design is largely in line with Garrett's classification, further chapters additionally address Corporate Strategy, Database Design, Usability Engineering, and Content Management as disciplines that affect and are affected by IA.⁴⁹

⁴⁹ While it cannot be the goal here to give an exhaustive description of all of these areas of expertise, an effort is made to characterize each of them as detailed as necessary to be able to explain its interrelations with Information Architecture. As these interrelations vary in degree and complexity, single chapters (e.g., Usability Engineering, Database Design) extend on one discipline more than others do, which then are deliberately kept short, in order to maintain a reasonable volume of the thesis. For more detailed information on each discipline, please refer to the literature listed in each chapter.

2.2.1 Corporate Strategy

2.2.1.1 Basics of Corporate Strategy

According to Leontiades (1985), modern understanding of corporate strategy (CS) evolved from purely company-centered to an environmental understanding. Thus, in the 1960s, Andrews (1965, as cited in Leontiades, 1985, p. 8) defined strategy as:

[...] the pattern of objectives, purposes or goals and major policies and plans for achieving these goals stated in such a way as to define what business the company is in or is to be in and what kind of company it is or is to be.

While this definition emphasizes the element of corporate direction in terms of defining goals for the business and means to achieve them, in the 1970s and 80s, emphasis was put rather on the task of matching a firm's business with its economic, political, social, or ecological environment; in this view, "the basic characteristics of the match an organization achieves with its environment is called its strategy" (Hofer & Schendel, 1978, as cited in Leontiades, 1985, p. 8; see also Porter, 1980, Bowman, 1974, as cited in Leontiades, 1985). Recently, Weber (2003) aligned these two lines of thought in describing strategy as long-term goals including the plans and means to achieve these goals, all aiming at adjusting the business to a changing environment.

A corporate strategy plays an important role as part of an overall business concept, which also includes descriptions of the business' mission and vision, its goals and deadlines, target group, necessary investments, and funding (Mihalic, 2002). According to Weber (2003), major characteristics of corporate strategies are:

- *Reduction*: reduce the complexity of variables determining the business' development
- *Relevancy*: select major variables, leave out minor important ones
- *Earliness*: anticipate changes and act proactively, not only react to changes

Strategies may pertain to the whole company (*corporate strategy*), single business units (*business strategy*), or functional departments (e.g., *procurement strategy*; Weber, 2003). In any case, a corporate strategy may include directions regarding the organization's:

- Products, markets, and competition⁵⁰
- Provision and ministration of resources⁵¹

⁵⁰ Examples include types of products or services that the business offers, types of customers that the business serves, geographic markets served, competitive strategies (Weber, 2003)

⁵¹ Examples include employees (knowledge and commitment), materials, and production system (Weber, 2003).

- Management system: e.g., flow of information, further education
- Socio-economic environment: e.g., fulfill obligations to society, shape corporate identity (Weber, 2003; Yip, 1992)

2.2.1.2 Where Information Architecture and Corporate Strategy Meet

As Rosenfeld (1999, ¶ 1) notes, “from a purely theoretical point of view, the point of information architecture is to connect users with content”. But as websites become more and more critical to an organization’s success, they cannot be operated in isolation from business goals and planning, and hence, corporate strategy is the third major factor in shaping an IA system (Rosenfeld, 1999; Morville, 2000b; Rosenfeld & Morville, 2002). More than usability engineering, which primarily relies on usability ratings as primary success criteria (see 2.2.6), IA practice has included explicit achievement of business goals as success criterion early on and has tried to balance user and business needs (e.g., Rosenfeld, 1999; Morville, 2000b). Thus, the “ultimate IA design goal [is] an information architecture that corresponds to your users’ mental model [and] that also meets your business needs” (Veen & Fraser, 2001, slide 64; see also Myer, 2002). Corporate strategy thus is a major driving force behind all IA efforts; as obvious from the IA process descriptions in 2.1.4, to develop a successful IA system, it is vital for information architects to have detailed knowledge of the organization’s:

- Business concept, including vision & mission, business goals, and competitors
- Business context and culture, e.g., stakeholders, decision structures, business mandate
- Resources, including time, money, and human expertise
- Marketing and brand concept (see also 2.2.4)

(Rosenfeld, 1999; Morville, 2000b; Veen & Fraser, 2001; Dijck, 2002; Myer, 2002; Ramsey, 2002; IconMedialab International AB, 2002; Zaudhaus LCC, 2003).

However, the relationship between IA and CS is bi-directional, i.e., IA in turn also influences corporate strategy development (Rosenfeld, 1999; Rosenfeld & Morville, 2002; see Figure 2-14). IA activities, in an effort to understand users, content, and context, often “expose serious inconsistencies and gaps within business strategy, particular in how it relates to the web environment” (Rosenfeld & Morville, 2002, p. 352; see also Morville, 2000b). The information architect may be well positioned to be the one who articulates those deficiencies and then “proceeds to work with managers, strategists, and stakeholders to put together a more sensible plan” (Rosenfeld & Morville, 2002, p. 352). In addition, information architects might also infuse innovation to any corporate strategy, identifying opportunities and challenges (Rosenfeld & Morville, 2002).

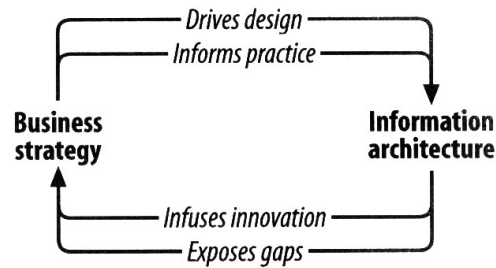


Figure 2-14: The bi-directional relationship of Information Architecture and business (corporate) strategy (Rosenfeld & Morville, 2002, p. 347)

In conclusion, IA and CS can be viewed as a typical chicken-and-egg problem: in a business environment of constant change with ever-increasing competition and technological pace, one is not possible without the other (Morville, 2000b; Rosenfeld, 1999). The optimal relationship, therefore, is one of symbiosis, where managers develop corporate strategies, and information architects pick them up, ask questions, give feedback, and both learn from each other (Morville, 2000b; Rosenfeld & Morville, 2002).

2.2.2 Interaction Design

2.2.2.1 Basics of Interaction Design

Alan Cooper and Robert M. Reimann, two renowned leaders of the field, view Interaction Design (IaD) as “the definition and design of the behavior of artifacts, environments, and systems, as well as the formal elements that communicate that behavior (2003, p.xxix). Garrett (2000, Web as software interface, ¶ 4) defines it as the “development of application flows to facilitate user tasks, defining how the user interacts with site functionality”, which goes in line with Jakob Nielsen’s “[IaD is] a matter of flow through a transaction or task” (interviewed in Thornton, 2002, p. 3). All of these definitions agree in the discipline’s focus on dynamic aspects of interactive systems, i.e., behavior and flows, rather than relatively static aspects like content organization or labels for content elements. Thus, major issues of IaD include:

- *Human/machine communication*: IaD acts as translator between technology and user
- *Action/reaction*: a communicative act comprises one or more cycles of action/reaction
- *State*: each cycle requires a clear display of the current state of the system
- *Workflow*: the communication frequently involves complex, multi-task activities⁵²
- *Malfunction*: IaD seeks to minimize misunderstandings / ease recovery from mistakes (Baxley, 2002; Cooper & Reimann, 2003)

⁵² For example, browsing for, selecting, and purchasing an item (Baxley, 2002)

The focus on behavior and tasks implies that, as Cooper and Reimann suggest, “interaction design approaches the design of products with a goal-directed perspective” (2003, p.xxix); another major implication is that the design of interaction is successful most likely when it recedes into the background, noiselessly supporting user’s tasks. To achieve this, IaD has to strike “a delicate balance between the needs and expectations of users and the capabilities and limitations of technology” (Baxley, 2003, ¶ 1).

In website development, IaD naturally lends itself to the design of complex transactions found in functionality-centric web applications rather than traditional content-centric websites. A web application can be defined as a website that exhibits two characteristics:

- *One-to-one relationship*: web applications establish a unique session with each user
- *Ability to permanently change data*: users can create, manipulate, and store data.

(Baxley, 2002; Baxley, 2003; Shubin, 1999)

Interaction design is rooted in a number of other disciplines, ranging from perceptual psychology to computer science, drawing theory and methods from traditional design as well as usability and engineering disciplines. Its approach to developing interaction designs, however, is similar to that taken in traditional design, rather than scientific or engineering approaches (Baxley, 2002; Cooper & Reimann, 2003).

2.2.2.2 Where Information Architecture and Interaction Design Meet

The distinction between content-centric and functionality-centric websites continues to be blurred because current websites have evolved to include both large volumes of content and sophisticated functionality (Baxley, 2002). Accordingly, the borders between IA and IaD have become fuzzy, and information architects frequently find themselves designing interaction, and interaction designers architecting information. Hence, the most typical deliverable of IaD, a flow diagram depicting a process (see Figure 2-15), is practically identical to IA’s interaction documentation blueprints (see 2.1.5.5). In Interaction-IA approaches (e.g., Wodtke, 2001a; see 2.1.2), Interaction Design is consequently viewed to be merely a sub-set of the overall discipline of IA. As similar as they might be, however, several distinctions between the two can be drawn, at least when referring to Library-IA vs. Interaction Design:

- **Focus**: while IA focuses on the organization and labeling of information, IaD concentrates on behavior and flows at the interface level
- **Goals**: IA aims at helping users to find and manage information, whereas IaD aims at helping users to complete tasks in general and achieve specified goals

- Objects: IA's main objects are words and hierarchies, whereas IaD deals with processes and activities.
 - Professional background: while the background for Information Architecture is LIS and HCI, IaD is rooted rather in traditional design and engineering
- (Veen & Fraser, 2001; Baxley, 2002; Rosenfeld & Morville, 2002; Cooper & Reimann, 2003)

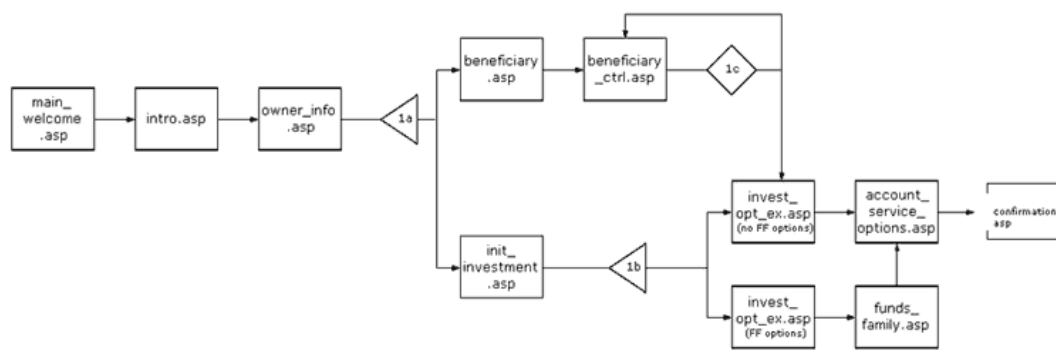


Figure 2-15: A sample task flow diagram (Doss, 2002)

To conclude, in today's highly complex websites, the realms of information architects and interaction designers often cannot be separated anymore. Thus, in practice, each one might take over responsibilities and task from the other without further notice; it remains, however, that they indeed are separate areas of expertise, and as the level of design complexity increases, so does the need for a dedicated specialist in both of the fields.

2.2.3 Information Design

2.2.3.1 Basics of Information Design

Information Design (ID) can be broadly defined as “the intentional process in which information related to a domain is transformed in order to obtain an understandable representation of that domain” (Peter J. Bogaards, 1994, as cited in Quine, 2003, p. 2). Quine (2003, p. 2) refers to it as “the art and science of preparing information so that it can be used by human beings with efficiency and effectiveness”. According to Molloy (2003), the discipline of ID has four branches:

1. Informatics: visualization of complex information⁵³
2. Wayfinding: creation of signs and design of (real) spaces⁵⁴

⁵³ For example, statistics, medical graphics, scientific diagrams; this branch is closely aligned with statistics and mathematics.

3. Interface design: design of human - technological interfaces⁵⁵
4. Guides and instructions: development of instructions, guides, forms, and manuals⁵⁶

The essence of ID, however, is to design the actual presentation of information, in order to make information accessible and usable, to communicate its meaning, and facilitate understanding. To achieve this, core tasks of ID involve defining, planning, gathering, filtering, and shaping information and the context in which it is presented (David Sless, 1990, as cited in Quine, 2003; Garrett, 2000; Jakob Nielsen, interviewed in Thornton, 2002; Quine, 2003). In doing so, an information designer relies on methods of writing, visual design, and statistical analysis to deliver information presented in charts, diagrams, graphs, tables, guides, instructions, directories, and maps (Tufte, 1990).

2.2.3.2 Where Information Architecture and Information Design Meet

As Saul Carliner (interviewed in Mazur, 2001) notices, IA and ID both share the same goal of effective information. Some experts even claim that there is no significant difference between the two (Nathan Shedroff, interviewed in Mazur, 2001; Knemeyer, 2003). Especially Wurman's definition of IA (see 2.1.2.1) lends itself to be viewed as being identical to ID as defined above (Knemeyer, 2003; Jesse J. Garrett, interviewed in Mazur, 2001). As Nathan Shedroff (interviewed in Mazur, 2001, p. 5) points out, each "focuses first on organization of data in order to transform it into information". In this view, the structuring of information lies at the core of both disciplines, while presentation of it or graphic design is just one additional aspect of ID. This confluence of IA and ID, together with Visual Design, becomes manifest in the wireframe of single pages or page templates (Vodvarka, 2000; Rosenfeld & Morville, 2002; Wodtke, 2002; see 2.1.5.4)

However, this notion of both being identical in scope ignores large parts of IA today (e.g., design of metadata schemata and controlled vocabularies). Consequently, especially in Interaction-IA, ID is viewed to be actually a subset of IA (Vodvarka, 2000; Christina Wodtke, interviewed in Mazur, 2001; Wodtke, 2001a; see 2.1.2.4). Vodvarka (2000) contends that, in website development, with a low- to medium level of information complexity that does not allow for a dedicated information designer, ID tasks are accounted for mostly by information architects, with additional contributions of graphic designers and system developers. In turn,

⁵⁴ This branch is closely aligned with architecture and exhibition display.

⁵⁵ For example, computers, phones, blenders, elevators, ATMs and VCRs; this branch is closely aligned with industrial design, computer science, graphic design, theatre studies, digital arts, and cognitive psychology.

⁵⁶ This branch is closely aligned with technical writing, document simplification, law, software design, and graphic design.

exponents of Library-IA, which leaves aside page-level design (see 2.1.2.2), emphasize differences between the two disciplines with regard to focus, skills, and milieu:

Different foci: while ID (and Wurman's IA) focuses on *page* design, i.e., presentation of information on a mostly two-dimensional plane, IA is rather about *site* design, i.e., organizing whole collections of pages in a three-dimensional space (Peter Morville, Lou Rosenfeld interviewed in Hill, 2000; De Rossi, 2001; Bob Jacobson, Jesse J. Garrett, interviewed in Mazur, 2001).

Different skills: information architects mainly use language as their tool, while information designers rather rely on visual arts; thus, many information designers have a background in graphic design, whereas information architects come from a variety of professional backgrounds (Jesse J. Garrett, interviewed in Mazur, 2001)

Different milieus: while IA deals with rather abstract and intangible issues of organizing information, information design is very concrete and tangible in its focus on display of information (Jesse J. Garrett, interviewed in Mazur, 2001).

To conclude, while in the beginning, Wurman's IA was virtually identical to traditional ID concepts, in the meantime the discipline of IA has matured and achieved a unique identity in focus, process, methods, and deliverables (Peter Morville, Lou Rosenfeld, interviewed in Hill, 2000; Knemeyer, 2003). However, the rivaling of the two disciplines has lead to a "point of general confusion" (Knemeyer, 2003, ¶ 1; see also Bob Jacobson, interviewed in Mazur, 2001). Thus, it seems beneficial to refine both disciplines separately, according to their different foci, while at the same time acknowledging the wide area of overlap and the need for collaboration.

2.2.4 Corporate Branding & Visual Design

2.2.4.1 Basics of Corporate Branding and Visual Design

In a narrow and plain sense, a *brand* is typically understood as a name given to a product or service, which proves ownership and separates the product/service from competitor products/services. In terms of product marketing, however, the conceptualization of a brand is much broader; thus, a brand can be described as a complex image in the minds of the target audience, which "is the sum of all factual, imaginary, rational and emotional attributes assigned to a product or service by the target audience" (Ruckelshauß & Prenzel, 2004, p. 272; translated by the author). This also includes typical brand attributes like the logo design, color

schemes, images, slogans, and the product's packaging. According to Ruckelshauß and Prenzel (2004), the elements of a brand can be categorized into three semantic levels:

1. Brand benefit: the tangible benefit of the product / service for the customer⁵⁷
2. Brand values: the beliefs and values the brand stands in for⁵⁸
3. Brand personality: the personality behind a brand⁵⁹

All of these definitions and models point to the key factor that determines the success of a brand: how a brand is perceived by the target audience, i.e., what benefits, values, and personality they assign to a brand. Accordingly, the purpose of *Branding*, the underlying process of developing and managing brands, is to evoke a particular perception of the product in the consumer's mind. Tangible goals of Branding processes thus might include:

- articulating a promise of stable or improved quality and performance to customers
- promoting customers' long-term trust
- improving customer loyalty and supporting stable customer relations
- maximizing profits by allowing for increased pricing through improved image

(Lackum, 2004; Ruckelshauß & Prenzel, 2004)

To achieve these goals, a comprehensive branding process is not restricted to corporate design⁶⁰, but may also cover aspects of corporate performance⁶¹ and corporate behavior⁶² (Lackum, 2004). For the former, the general process of developing a brand can be described as outlined in Table 2-6.

Table 2-6: Basic Corporate Branding process

Basic Corporate Branding process	
1. Analysis of:	
a.	Business-domain specific design trends and brand labeling trends
b.	Socio-demographic data of the target audience (age, education, income level, place of residence, etc.)
c.	Psychographic data of the target audience (brand image, expectations/desires, values/goals/interests, models)
d.	Competitors' brand status
e.	If existing: status quo of brand (customer insight, competitive brand status, brand image, brand architecture)
2. Strategic brand concept development, including:	
a.	Key brand benefit

⁵⁷ Example for brand benefit: a car allows for personal freedom.

⁵⁸ Example for brand values: a BMW represents love of life, power, ambition, and elite.

⁵⁹ Example for brand personality: a BMW's brand personality can be described as male, open-minded, extroverted, single (all examples: Ruckelshauß and Prenzel, 2004)

⁶⁰ Corporate design: all of a company's visible statements, equaling the visible expression of a company's corporate identity / product identity (Lackum, 2004)

⁶¹ Corporate performance: the sum of all products and services offered by a company (Lackum, 2004)

⁶² Corporate behavior: the way a company interacts with clients, employees, suppliers, and investors (Lackum, 2004)

b. Desired brand values
c. Desired brand personality
d. Verbal brand concept, tonality
e. Visual brand concept, tonality
3. Brand name development
a. Listing brand name alternatives
b. Similarity research, copyright research
c. Choosing three to four favorites
d. Evaluating acceptance level and semantic spectrum with target audience, decision
4. Brand design: creative realization of a brand, including:
a. Developing several alternative brand design visions, including key visuals, logotype, typography, color schemes, layout grids, and design examples
b. Testing brand designs: association spectrum and acceptance level of designs (satisfaction, sympathy / interest, identification)
5. Implementation
a. copyright documentation
b. brand design style guide
6. Maintenance (Brand Management)
a. Conceptual phase: analyze status quo of brand and target audience (steps 1.a-e); develop creative brief
b. Coding phase: creative realization (steps 2-5)
c. Reception phase: target audience interpretation of and response to brand

Note. Sources: Lackum, 2004; Langner, 2003; Ruckelshauß & Prenzel, 2004; Schneider, Kahn, Zenhäuser, & Haring, 2003.

As outlined above, a major portion of branding activities focus on the creative realization of all visual statements of a company. Hence, a discipline heavily involved in branding processes is *Visual Design* (VD). In the narrow context of interface development for interactive products, Visual Design can be viewed as a discipline concerned with “the appearance, organization and layout of the graphical elements found in any type of user interface” (Mouseworks-media, 2003, Visual Interface & Icon Design, ¶ 1). Garrett (2000) describes its focus as the visual treatment of text, graphic page elements, interface elements, and navigational components.

The overall goal of VD is to develop a visual language for the product, which then describes the visual characteristics of a particular set of design elements and the way they relate to each other (Mullet & Sano, 1995)⁶³. To develop such a visual language, VD employs a process “comparable to typical engineering methodology” (Mullet & Sano, 1995, p. 1): grounded in thorough background research, a deep understanding of the problem leads to an iterative cycle of design generation and evaluation until a solution meets specified success criteria and is selected for production. In doing so, VD can rely on basic design principles, including:

⁶³ Design elements, in this respect, can be: point, line, plane, and volume; visual characteristics include their shape, size, position, orientation, color, texture, etc.; their relationships can be described in terms of visual balance, rhythm, structure, proportion, etc. (Mullet & Sano, 1995)

- *Contrast*: difference between design elements regarding a given visual characteristic
- *Repetition*: reiterating visual characteristics and visual elements
- *Alignment*: visually connecting elements, especially through positioning and layout
- *Proximity*: relating visual elements to one another through closeness

(Mullet & Sano, 1995; Williams, 2003)⁶⁴

2.2.4.2 Where Information Architecture and Corporate Branding / Visual Design Meet

On the web, a company's competition for customer attention and market share is complicated by many factors not relevant to traditional business, like usability of the website or delays in server response times (see also 2.3.2). Realizing a clear and distinct brand for the website is thus even more important as for more traditional products or services. In turn, the website, and hence its underlying IA system, must complement the image built in other media, in order to support the overall success of the brand (Reiss, 2000; Ruckelshauß & Prenzel, 2004). For most IA projects, a previously defined, corporate-wide brand design is typically already available; depending on the applicability of this existing brand design in online environments, however, additional customization effort might still be required, which then involves collaborative efforts of information architect, sales & marketing specialists, and visual designers (Lackum, 2004; Ruckelshauß & Prenzel, 2004).

This collaboration of IA and VD professionals becomes especially necessary when defining wireframes. As an IA deliverable, wireframes are supposed to convey primarily grouping, relationships, and priority of content elements on a page, which is most commonly achieved by sketching its basic layout (see 2.1.5.4). Defining the layout, however, i.e., determining the shape, size, and position of design elements, is also a crucial part of the visual language for a page, and cannot be treated in isolation from other visual characteristics of design elements, like color or texture; rather, the coherent development of design elements and their characteristics are a major prerequisite to developing successful visual designs (Mullet & Sano, 1995). However, even with this overlap in focus, in general, the two disciplines rather complement each other than rival (Myer, 2002; Jesse J. Garrett, interviewed in Mazur, 2001; Alison J. Head, interviewed in Rhodes, 2001b).

⁶⁴ In cognitive research, these principles of design have been shown to affect significantly human visual perception; for more, see 2.1.2.5: Gestalt principles of human perception.

2.2.5 Database Design & System Development

2.2.5.1 Basics of Database Design and System Development

A database provides a repository for data; it can be defined as “a collection of data arranged for ease and speed of search and retrieval” (Rosenfeld & Morville, 2002 p. 70). A database is made up of single *records*, and each record may comprise several *fields* that include data about the respective record. Historically, there have been several models of how data is stored in a database, including flat files, hierarchical, network, relational, and object-oriented data models (Harrington, 2000). Out of these, the relational data model is the one most prevalent today (Rosenfeld & Morville, 2002). In a relational database, records are stored in tables. These tables, not unlike spreadsheets, list records in rows, while the fields are listed in columns. At the intersection of a row and a column, a data value is stored, describing the value for a specific record’s attribute (Roman, 1999; see Figure 2-16).

AUTHOR						AUTHOR_TITLE	
au_id	au_lname	au_fname	address	city	state	au_id	title_id
172-32-1176	White	Johnson	10932 Bigge Rd.	Menlo Park	CA	172-32-1176	PS3333
213-46-8915	Green	Marjorie	309 63rd St. #411	Oakland	CA	213-46-8915	BU1032
238-95-7766	Carson	Cheryl	589 Darwin Ln.	Berkeley	CA	213-46-8915	BU2075
267-41-2394	O'Leary	Michael	22 Cleveland Av. #14	San Jose	CA	238-95-7766	PC1035
274-80-9391	Straight	Dean	5420 College Av.	Oakland	CA	267-41-2394	BU1111
341-22-1782	Smith	Meander	10 Mississippi Dr.	Lawrence	KS	267-41-2394	TC7777
409-56-7008	Bennet	Abraham	6223 Bateman St.	Berkeley	CA	274-80-9391	BU7832
427-17-2319	Dull	Ann	3410 Blonde St.	Palo Alto	CA	409-56-7008	BU1032
472-27-2349	Gringlesby	Burt	P0 Box 792	Covelo	CA	427-17-2319	PC8888
486-29-1786	Locksley	Charlene	18 Broadway Av.	San Francisco	CA	472-27-2349	TC7777

TITLE					PUBLISHER		
title_id	title	type	price	pub_id	pub_id	pub_name	city
BU1032	The Busy Executive's Database Guide	business	19.99	1389	736	New Moon Books	Boston
BU1111	Cooking with Computers	business	11.95	1389	877	Binnet & Hardley	Washington
BU2075	You Can Combat Computer Stress!	business	2.99	736	1389	Algodata Infosystems	Berkeley
BU7832	Straight Talk About Computers	business	19.99	1389	1622	Five Lakes Publishing	Chicago
MC2222	Silicon Valley Gastronomic Treats	mod_cook	19.99	877	1756	Ramona Publishers	Dallas
MC3021	The Gourmet Microwave	mod_cook	2.99	877	9901	GGG&G	München
MC3026	The Psychology of Computer Cooking	UNDECIDED	877		9952	Scootney Books	New York
PC1035	But Is It User Friendly?	popular_comp	22.95	1389	9999	Lucerne Publishing	Paris
PC8888	Secrets of Silicon Valley	popular_comp	20	1389			
PC9999	Net Etiquette	popular_comp		1389			
PS2091	Is Anger the Enemy?	psychology	10.95	736			

Figure 2-16: Tables of a relational database (“Introduction to Data Modeling”, 2003)

The relational model has been extended by Chen (1976) to the entity-relationship model, which supports global relations between tables (Steiner, 2000). Its three main components are entities, relationships, and attributes:

Entities are distinct objects that need to be represented in the database; this may include people, places, things, events, and concepts of interest; in Figure 2-16, book title, author, and publisher all constitute entities (Simovici & Tenney, 1995; Robinson, 1999; Roman, 1999).

Attributes describe properties of entities and relationships. They are used to store the information needed for each entity, to identify individual entities unambiguously, and to specify relationships between entities (Simovici & Tenney, 1995; Roman, 1999).

Relationships reflect the interactions between entities (Simovici & Tenney, 1995). There are three types of relationships between two entities:

- Many-to-many: e.g., one book may have many authors, one author may write many books
- One-to-many: e.g., one publisher may publish many books, but a book is published by at most one publisher
- One-to-one: e.g., one contributor to a book is also exactly one co-author & vice versa⁶⁵ (Roman, 1999; Robinson, 1999)

Entities, attributes, and relationships are visualized using an entity-relationship diagram, which typically specifies the data that must be captured, stored, and retrieved, as well as the data required to report on specific performance measures (Robinson, 1999; see Figure 2-17).

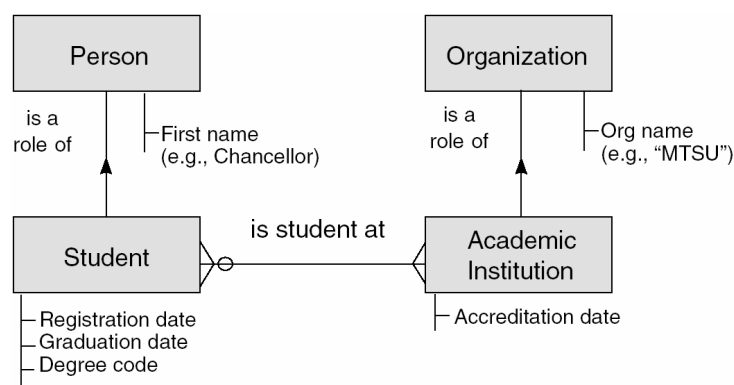


Figure 2-17: A simple Entity Relationship Diagram (English, 1999, p. 18)

Data modeling, “the art of identifying the entities that must be represented in a database and the relationships among those entities” (Harrington, 2000, p. 3), is thus a key element of the database design (DD) and system development process (Stephens & Plew, 2001). Although there are various database design methods available, the basic process can be summarized as shown in Table 2-7.

Table 2-7: Basic Database Design process

Basic Database Design process	
1. Planning and analysis	
▪ capturing business needs, including all data, processes, and rules that comprise a business	
▪ determining what information is needed, who will deliver it, who will need it	

⁶⁵ One-to-one relationships are somewhat redundant and can be eliminated by introducing one entity comprising all attributes of both original entities

▪ addressing needs of application users
▪ addressing needs of system users
2. Conceptual design
▪ documenting the business model of the organization, e.g., using a basic Entity Relationship Diagram
▪ documenting the process model of the organization, e.g., using flow charts
3. Logical design
▪ defining entities in more detail by adding attributes, defining different properties of each attribute, and re-fining relationships
▪ employing process models to determine how end users access the database
▪ further defining end user access by prototyping views and query forms
4. Physical design (including data normalization)
▪ logical model is converted into a physical database structure, database is normalized
▪ Views, access paths, and query forms are created to enable end user access
5. Implementation
▪ documenting the database
▪ building the database
▪ preparing data
▪ testing end user application with real data
▪ porting the database into its production environment

Note. Sources: Introduction to Data Modeling, 2003; Harrington, 2000; Stephens & Plew, 2001; Stickel, 1991.

2.2.5.2 Where Information Architecture and Database Design Meet

As Rosenfeld and Morville contend, “metadata is the primary key that links information architecture to the design of database schema” (Rosenfeld & Morville, 2002, p. 70). A metadata schema defined by an information architect can be implemented using relational databases in that each metadata attribute is translated into a column of a relational table (Svec, 2000, Warren, 2001). In doing so, metadata might either be directly included in a relational table that also contains the data objects to be described by the metadata attribute, or can be implemented in a separate table or database, linked to the respective pool of documents or other information objects addressed (Rosenfeld & Morville, 2002). In any case, user needs identified in IA help to drive database and system design, but at the same time, technological constraints have to be factored into the design of the system’s IA (Forsman, 2003)

While Data Modeling is listed to be one of many roots information architects come from (Rosenfeld, 2001; IAwiki, 2003), only a few actually are responsible for or have experience in Data Modeling (Garrett, 2000a). However, the IA method of content modeling, as described by Rosenfeld and Morville (2002), is very similar to Data Modeling in that it also specifies objects, their (metadata) attributes, and relationships, if however, does so on a document / information, not data level. Some information architects believe that IA and Data Modeling have to go hand in hand, if not have to be done by the same person, in order to leverage the synergies between DM and IA (Phil Arko, Siemens AG, verbal communication, September 12, 2003). However, in many cases, the information architect might “be better off working

with a professional programmer or database designer who really knows how to do this stuff” (Rosenfeld & Morville, 2002, p. 70), in order to fully leverage the power of the Data Modeling to support effective browsing and searching (e.g., dynamically generated alphabetical indexes and “see also” links, fielded searching, and mechanisms for filtering and sorting search results; Rosenfeld & Morville, 2002).

2.2.6 Usability Engineering & User-Centered Design

2.2.6.1 Basics of Usability Engineering and User-Centered Design

According to the ISO 9241-11 (1998, p. 2), *usability* describes the “extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use”.⁶⁶ While this definition focuses on characteristics of the *process* of the interaction between user and system, Nielsen (1993) defines usability in terms of key attributes of the *product*:

- *Learnability*: the system should easily be learned
- *Efficiency*: the system should facilitate efficient use
- *Memorability*: the system should be easy to remember
- *Errors*: the system should minimize errors, enable easy recovery, prevent fatal errors
- *Satisfaction*: the system should be pleasant to use

Additional attributes of usable products are provided by the dialogue principles for ergonomic design laid down in the ISO9241-10 standard (see Table 2-8; ISO9241-10, 1996):

Table 2-8: Dialogue principles for visual display terminals

Dialogue principle	Description
Suitability for the task	The dialogue supports effective and efficient completion of a task.
Self-descriptiveness	Each dialogue step is immediately comprehensible through feedback from the system or is explained to the user on request.
Controllability	The user is able to initiate and control the direction and pace of the interaction until the point at which the goal has been met.
Conformity with user expectations	The dialogue is consistent and conforms to the user characteristics and to commonly accepted conventions.
Error tolerance	Despite evident errors in input, the intended result may be achieved with either no or minimal corrective action by the user.
Suitability for individualization	The interface software can be modified to suit the task needs, individual preferences, and skills of the user.
Suitability for learning	The dialogue supports and guides users in learning to use the system.

Note. Source: ISO9241-10, 1996, pp. 3-8.

⁶⁶ *Effectiveness*, in this respect, is defined as the accuracy and completeness with which users achieve specified goals; *efficiency* as the resources expended in achieving these goals in relation to the effectiveness, and *satisfaction* as freedom from discomfort and positive attitudes towards the use of the product (ISO 9241-11, 1998).

Each of these two conceptualizations of usability (process- vs. product-oriented), in turn, lends itself to individual operationalizations and evaluation methods:

Evaluating usability in terms of characteristics of the product: Characteristics of the system can be assessed by expert evaluations focusing on compliance with usability guidelines, heuristics, and standards (e.g., performing a heuristic evaluation, see below).

Evaluating usability in terms of characteristics of the process: The interaction between user and system, in contrast, can validly be assessed only by observing actual users using the system (e.g., by conducting usability tests; see below). Table 2-9 shows exemplary measures for this interaction (for measures tailored to specific product properties, see Appendix A-1)

Table 2-9: Examples of measures for usability

Effectiveness measures	Efficiency measures	Satisfaction measures
<ul style="list-style-type: none"> ▪ Percentage of goals achieved; ▪ Percentage of users successfully completing task; ▪ Average accuracy of completed tasks 	<ul style="list-style-type: none"> ▪ Time to complete a task; ▪ Tasks completed per unit time; ▪ Monetary cost of performing the task 	<ul style="list-style-type: none"> ▪ Rating scale for satisfaction; ▪ Frequency of discretionary use; ▪ Frequency of complaints

Note. Source: ISO 9241-11, 1998, p. 10.

Both the definition of usability in ISO 9241-11 as well as Nielsen's key usability attributes, however, explicitly include the user's subjective feeling of satisfaction while using the product as a key aspect of usability, which discriminates the concept usability from other quality attributes of a software product, e.g., functionality, reliability or overall computer performance (as for example defined in ISO/IEC 9126, 2001). It is important to note that the usability of a product is always closely tied to the *context of its use*, which includes characteristics of the users, their tasks, the equipment (hardware, software and materials) they use, and the physical and social environments in which they use the product (ISO 9241-11, 1998; Abran, Khelifi, & Suryn, 2003).⁶⁷ Even though usability therefore is "a measurable characteristic of a product [...] that is present to a greater or lesser degree" (Mayhew, 1999, p. 1), it can only be evaluated for a specified user with specified tasks and equipment in a specified environment (ISO 9241-11, 1998).

Usability Engineering (UE), then, is "a process for defining, measuring, and thereby improving, the usability of products" (Wixon & Wilson, 1997, p. 654). Nielsen (1993) broadly defines UE as the sum of all steps and activities during product development that help to

⁶⁷ Another product-oriented, previously context-independent conceptualization of usability, the ISO/IEC 9126 standard on software quality (1991, 2001), only recently was changed to account for this dependence of usability measures on the context of use (Abran et al., 2003).

achieve a high usability of the product to be developed. In that, UE integrates Engineering Psychology expertise (see 2.1.2.5) in the overall product development process⁶⁸, if however, it also draws from several other disciplines, including Cognitive and Experimental Psychology, Ethnography, and Software Engineering (Mayhew, 1999).

Usability Engineering originally was concerned with basic issues of (software and hardware) usability of desktop applications, turning to web usability with the advent of the WWW in the 1990s. Recent and future directions include internationalization of interfaces (DelGado & Nielsen, 1996; Luong, Lok, Taylor, & Driscoll, 1995), accessibility of computer systems (Slatin & Rush, 2002; Mueller, 2002), and mobile and ubiquitous computing and communication (Stanton, 2001; Weiss, 2002; Lindholm & Keinonen, 2003).

Some experts virtually equate UE with user-centered design (e.g., Rubin, 1994); however, the term *User-Centered Design* (UCD; also “human-centered design”) describes rather a general approach to product development (Garrett, 2002a; Wodtke, 2001a): thus, UCD involves “approaches which have as their primary intention or focus the consideration of the interests or needs of the individuals and/or groups which will work with or use the output from a system” (ISO/TR 18529, 2000, p. 2). In this sense, any discipline involved in system development can be user-centered, as far as it meets these requirements.

The rationale for adopting a user-centered design approach capitalizes on the direct and indirect benefits of systems that are easier to understand and use. In turn, this improves user satisfaction and reduces discomfort and stress, which again leads to higher perceived product quality, adds to the product’s competitive advantage, and thus maximizes return on investment for the sponsoring organization (ISO 13407, 1999). Table 2-10 shows major benefits of a user-centered design approach⁶⁹. The fact that many of these benefits were also mentioned in 2.1.6 as impact of IA efforts points to the shared focus of both disciplines as described below in 2.2.6.3.

Table 2-10: Major benefits of a user-centered design approach

Major benefits of a user-centered design approach
For the development process: cost savings through:
<ul style="list-style-type: none"> ▪ Reduced development time ▪ Reduced development costs ▪ Reduced costs due to changes late in the design life cycle
For the product: higher quality through

⁶⁸ Accordingly, UE is also sometimes referred to as Human Factors Engineering or Ergonomics. While these terms reflect the discipline’s origin, in this work, the term Usability Engineering is preferred due to its well-defined focus and scope.

⁶⁹ For details on return on usability and IA investments, and a sample ROI calculation, see 2.3.5.3.

- Improved product definition
- Improved product design
- Increased product performance

For users and customers: improved goal achievement through:

- Increased user productivity
- Decreased user errors
- Increased user satisfaction

For the organization: improved return on investment through:

- Increased sales and market penetration, reduced time to profitability
- Increased user loyalty, repeat and referral sales
- Reduced personnel costs
- Reduced training and help desk costs
- Reduced resources spent on user support
- Reduced maintenance costs
- Reduced facilities storage costs

Note. Sources: Mayhew & Mantei, 1994; ISO 9241-11, 1998; Nielsen, 1993; Karat, 1997; Mayhew, 1999; Rosson & Carroll, 2002; Marcus, 2002a.

The ISO 13407 standard on human-centered design processes for interactive systems (1999) provides a framework for UE processes. Thus, all UCD processes cover four basic steps:

1. Understand and specify the context of use
2. Specify the user and organizational requirements
3. Produce design solutions
4. Evaluate designs against requirements

(ISO 13407, 1999, p. 5; see Figure 2-18)

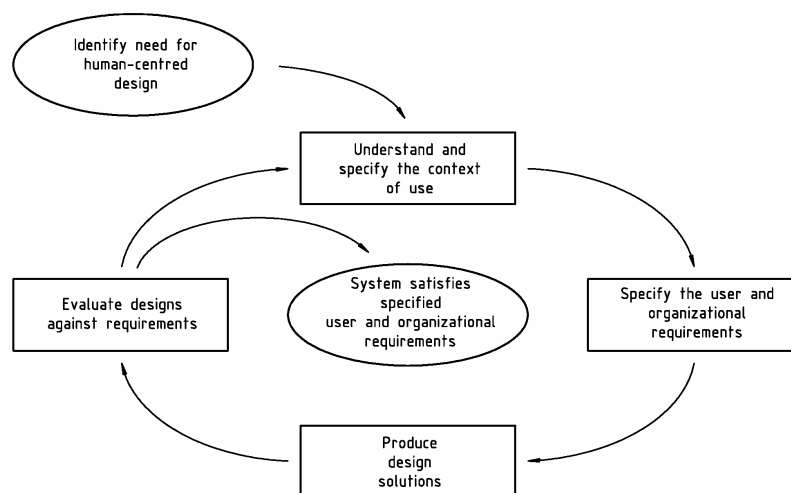


Figure 2-18: Basic activities in human-centered design processes (ISO 13407, 1999, p. 6)

Figure 2-18 emphasizes a key characteristic of UCD processes, being the iterative nature of the process flow. As the circular arrangement of steps implies, the sequence of analytical, creative, and evaluative tasks is reiterated until design goals are met. To avoid costly design changes late in the process, iterations should also be performed with preliminary concepts and design solutions (Nielsen, 1993; Mayhew, 1999). In analysis and evaluation, user-centered

approaches rely on active involvement of users as a “critical source of information” (ISO 13407, 1999, p. 3). Additional characteristics of UCD processes thus include a focus on user and task requirements, the objective to allocate function appropriately between users and technology, and a multi-disciplinary team (ISO 13407, 1999).

The overall UCD process framework of ISO 13407 can be viewed as the common foundation of many available usability engineering process models (see for example, Nielsen, 1993; Wixon & Wilson, 1997; Mayhew, 1999; Rosson & Carroll 2002), which however vary in terms of scope and level of detail. For example, in Mayhew’s comprehensive “Usability Engineering Lifecycle” (1999), the actual activities performed to arrive at the design solutions in step 3 of the UCD process framework (see Figure 2-18) are explicitly and in detail described, while they have been disregarded in many other UE process models (e.g., Wixon & Wilson, 1997; also Nielsen, 1993). By also embracing the actual design of the user interface, Mayhew’s process model thus incorporates the focus of traditional User Interface Design in the term’s narrow sense of designing interface elements to facilitate user interaction with functionality (Garrett, 2000; see 2.2.6.2). Summing up the available UE process descriptions, the typical UE process can be summarized as outlined in Table 2-11. Within this overall process, UE adopts a variety of basic UCD methods to ensure high usability of the future product; in the following, major methods are introduced⁷⁰.

Table 2-11: Basic Usability Engineering process

Basic Usability Engineering process	
1. Project setup	
a. Define project budget & project plan	
b. Set up usability team	
c. Define overall product concept	
2. Analysis	
a. Define business & usability goals	
b. Identify technical capabilities & constraints	
c. Analysis the context of use	
d. Gather user requirements	
e. Competitive analysis	
3. Design, prototyping, testing, iterative refinement	
a. Conceptual design, formative evaluation, & iterative refinement	
b. Prototyping, formative evaluation, & iterative refinement	
c. Summative evaluation, & iterative refinement	
d. Document deliverables	
4. Implementation	
a. Develop manual / tutorial	
b. Ensure product training & support	
5. Maintenance	

⁷⁰ As mentioned in 2.1.5, all of these methods also are applied in IA processes; however, as they have been originally developed and refined, and also are frequently applied in other UCD disciplines, they are listed here.

a. Analyze user feedback
b. Benchmarking

Note. Sources: Beyer & Holtzblatt, 1998; Liu, 1999; Mayhew, 1999; Nielsen, 1993; Rosson & Carroll 2002; Shneiderman, 1998; Wixon & Wilson, 1997.

Interviews and Questionnaires

Interviews and questionnaires are both methods of inquiry: at their core, both involve asking users a set of questions and recording their answers. While in interviews, this is achieved in personal dialogue between interviewer and interviewee, a questionnaire involves a set of written or printed questions handed over to the respondent, and thus, there is no need for the analyst to be present during its completion (Nielsen, 1993; Maguire, 1998; Rubin, 1994). Any interview or questionnaire can be classified according to degree of structure imposed on it:⁷¹

- *Structured interviews* (and *closed questionnaires*) prescribe questions as well as possible answers to each. Thus, they should only be performed when the domain in question and the range of potential answers are well known, and merely strength of opinion is assessed.
- *Semi-structured interviews* (and *open questionnaires*) include predefined questions, which can be answered in a free manner by the respondent. Thus, they are useful when broad issues may be understood, but not the range of respondents' reactions to them.
- *Non-structured interviews* leave both questions and answers open.⁷² They are helpful for exploratory investigations, when the topic is not clearly understood yet at all.

(Frieling & Sonntag, 1987; Maguire, 1998; Daly-Jones, Bevan, & Thomas, 1999)

For interviews, apart from this, several sub-types have been developed in the social sciences:

- *Focused interviews* concentrate on a particular situation or topic that all interviewees experienced or are experienced in. The goal is to identify the personal aspects of those experiences (Merton & Kendall, 1979).
- *Expert interviews* focus on clearly defined aspects of reality, while ignoring others, particularly private experiences. An expert can be defined either (1) through her being responsible for the planning, implementing, or supervising the solution of a problem, or (2) through her being in control of privileged access to information about persons or decision processes (Meuser & Nagel, 1991).

⁷¹ Structure, in this context, refers to the degree of freedom both the inquirer has in asking and the respondent has in answering questions.

⁷² Accordingly, there is no questionnaire equivalent.

- *Field interviews* are characterized by the natural, realistic setting, in which they are performed, such as an interviewee's office or home (Nielsen, 1993; Rubin 1994).
- *Contextual inquiry* (CI) is a field interview that focuses on interviewees' work practice, including their mental models of how something works, their goals, tools and methods, terminology, and the values by which they are driven. Although CI can be very time-consuming, it yields a wealth of valuable data, especially when analyzing work practices in domains not well known to the team (Hom, 1996; Gaffney, 1999b; Kuniavsky, 2003a).
- *Talk-throughs* are also used to analyze work practices and tasks; however, interviewees are asked to recall answers from memory; thus, talk-throughs do not have to be performed in the actual work environment as in CI, and, unlike walkthroughs (see below), do not require prototypes. Results run the risk of remaining incomplete and inaccurate due to the dependence on interviewee's memory (Kirwan & Ainsworth, 1992).

As a research method, conducting interviews yields various benefits, including:

- They are well suited for assessing actual usage, subjective satisfaction, and anxieties
- They are especially useful for exploring domains not well known yet to the researcher
- Areas which require more detailed analysis can be adaptively followed in the same session
- Quick and relatively cheap to carry out, compared to observational methods
- Close contact to users frequently returns ready-to-implement design recommendations
- Can promote 'buy-in' as users come to feel that their views are being taken account of (Daly-Jones et al., 1999; Nielsen, 1993; Shneiderman, 1998)

However, potential shortcomings of conducting interviews are:

- The interviewer may need to acquire extensive domain knowledge prior to interviews.
- What users say depends largely on the interviewer's skills to ask questions correctly.
- Interviewees can have difficulties in articulating their concerns.
- What interviewees say may differ from reality (e.g., due to social desirability bias)
- Interviewers may put their own biased interpretation on what is said.
- Analysis of resulting audio or written data can be very time-consuming.
- Interviewing only a small fraction of the user population can lead to biased results (Daly-Jones et al., 1999; Kuniavsky, 2003; Nielsen, 1993; Shneiderman, 1998)

Questionnaires are employed in UE processes for analytical as well as evaluative purposes. For the former, questionnaires can help to collect basic data on the context of use, e.g., on demographic data, computer literacy, etc. For the latter, questionnaires are used to identify

strengths and weaknesses of a product on various dimensions. A questionnaire thereby allows for assessing subjective ratings of participants in a standardized manner. Examples include:

- IsoMetrics^L (Willumeit, Gediga & Hamborg, 1996; 75 items)
- ISONORM 9241/10 (Prümper & Anft, 1993; 35 items)
- Software Usability Measurement Inventory (SUMI; Kirakowski, 1998; 50 items).
- 5 Usability Dimensions Attitude Scale (5-UD, ISO DIS 9241-11, 1993; 5 items)

All of them measure the usability of a product in terms of ISO 9241⁷³ (see above); however, due to the difference in the number of items, each questionnaire involves its own level of detail and completion time, and therefore, each is more or less suitable for a specific setting.

The *5 Usability Dimensions Attitude Scale* (5-UD) has been introduced in the Draft for ISO DIS 9241-11 (1993) by Nigel Bevan (Human Factors Research Group, University College Cork/Ireland). It was extracted from the Software Usability Measurement Inventory (short: SUMI; Kirakowski, 1998). The 5-UD measures user's satisfaction with a software product in terms of its overall acceptability, which in turn is one major component of usability. In essence, the questionnaire is a semantic differential scale that covers five usability dimensions that emerged during the development of the SUMI questionnaire. Each dimension is operationalized in the 5-UD with one item (see Table 2-12), with respondents rating it on a 9-point scale. Anchors (i.e., end points) for each scale are derived from the polar opposites of each SUMI dimension. Respondents are asked to rate the software by circling one number along the scale from 1 (worst possible) to 9 (best possible; ISO DIS 9241-11, 1993; see Appendix A-2 for the standard 5-UD questionnaire).

Table 2-12: Dimensions and items of the 5-UD

Dimension	Item
Efficiency	"How efficient do you feel you get your work done with this software?"
Affect	"Do you like using this software?"
Helpfulness	"Does this software help you how to use it?"
Control	"Do you feel in control when you use this software?"
Learnability	"Do you think it is easy to learn to use the system?"

Note. Source: ISO DIS 9241-11, 1993.

Due to its short completion time (about two to five minutes), the 5-UD is well suited to be administered after every single task a user performs in a usability test (see below). In terms of psychometric test qualities, this ensures high economy of effort and utility of the question-

⁷³ The former two were derived from the design principles defined in ISO 9241-10 (1996), while the latter two trace back to part 11 of the ISO 9241 (ISO DIS 9241-11, 1993; ISO 9241-11, 1998)

naire. In addition, the factor-analytical extraction of its dimensions and items from the methodically evaluated and tightly controlled SUMI questionnaire provides an extensively validated basis for the 5-UD ensuring internal validity. The few test items, though, involve potentially low reliability scores, which reduces the 5-UD's sensitiveness to detect differences in user satisfaction *between* products. However, it is a long-established tool that has been successfully applied internationally in different contexts to identify overall user satisfaction *within* one product (positive, negative, or indifferent), as shown in various publications (e.g., Epstein & Beu, 2000; Burmester, 2001; Komischke, McGee, Wang, & Wissmann, 2003; Wittenberg, 2004). Data analysis for the 5-UD can be done by computing measures of central tendency and dispersion for each of the five items across participants. While the usually ordinal-scaled data resulting from rating scales originally only allows for computing median values and range, interval-scaled data can be achieved, and thus mean values and standard deviations can be derived, in case of numerical data points and equidistance between data points within each scale. With the 5-UD, this can be realized by explicitly making respondents aware of the equal distance between the numerical data points (Bortz, 1993; Hüttner, 1999).

Questionnaires, due to their similarity to interviews in focus and procedure, also exhibit similar benefits and shortcomings⁷⁴. However, there are significant differences between the two, and thus, the method to choose depends on the particular research context:

- Interviews are more flexible in adapting to a individual respondent's concerns
- Interviews can be more free-form (e.g., spontaneously adding follow-up questions)
- Interviews generate immediate results; questionnaires are subjected to response delays
- Questionnaires frequently suffer from a low response rate
- Especially closed questionnaires are less laborious to perform and to analyze
- Questionnaires can easily be administered to large sample sizes
- Questionnaires are better suited for returning numerical results
- Interviews are subjected to scheduling constraints

(Daly-Jones et al., 1999; Nielsen, 1993; Shneiderman, 1998)

The data resulting from interviews (as well as open questionnaires) can be analyzed using a method called "Qualitative Content Analysis" (Mayring, 2000; 2003). In Qualitative Content Analysis, apparent and latent aspects of fixed communication are analyzed in a systematic, rule- and theory-based manner (Mayring, 2003). Three basic types have been identified: In (1) *summarizing*, the goal is to reduce the material by transforming it to a higher level of abstrac-

⁷⁴ For example, both are well suited for assessing subjective satisfaction; both can suffer from biased responses.

tion; (2) *explicating* aims at explaining single text passages by combining them with others, and in (3) *structuring*, individual text passages are organized using a well-founded system of categories. The main focus of Qualitative Content Analysis is on this latter structural analysis, while the former two are often necessary, preliminary steps (Mayring, 2003). There are two approaches to structuring: inductive and deductive. In *inductive category development*, categories are derived from the material according to specific criteria, and then are iteratively validated and refined. In *deductive category application*, previously defined, theory-based categories are systematically assigned to individual text passages, and also iteratively validated and refined (see Figure 2-19).

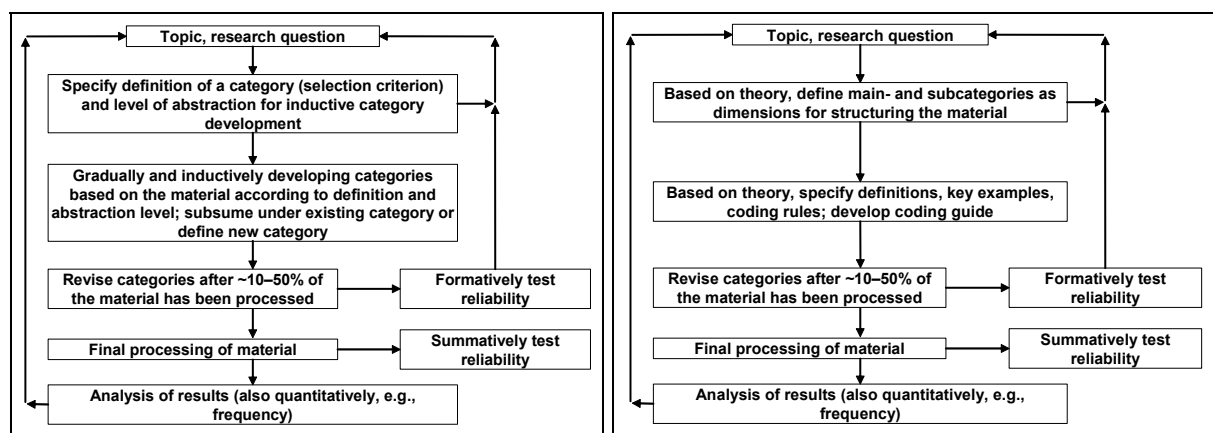


Figure 2-19: Inductive category development (left) and deductive category application in Qualitative Content Analysis (right; adapted from Mayring, 2003)

Focus Groups

In the context of Usability Engineering, focus groups are moderated discussion groups typically used early in the process, e.g., to identify user goals, tasks, and needs, discuss competitor products, prioritize features, or generate design ideas (Kuniavsky, 2003a; Rubin, 1994); however, Nielsen (1993; see also Daly-Jones et al., 1999) notes that they can also be employed to collect customer feedback. While participants typically include representatives of the target audience of the product, focus groups might also be conducted with development, marketing, or product management stakeholders. The ideal number of participants ranges from six to nine (Nielsen, 1993). Depending on the type of discussion (open-ended vs. highly structured), the moderator follows a more or less detailed script to keep the discussion on track (Nielsen, 1993). The major advantage of focus groups is that they can draw on the interaction of participants and groups dynamics to elicit creative ideas.

Participatory Design

Participatory Design describes “as much a philosophy as a set of techniques” (Kuniavsky, 2003a, p. 468). At its core, Participatory Design is about involving the user in actual development efforts. Implemented as an overall design philosophy, this might involve the user becoming an actual member of the design team, which has lead some to call Participatory Design an actual “embodiment of user-centered design” (Rubin, 1994, p. 22; Kuniavsky, 2003a). However, plain Participatory Design workshops can also be integrated in traditional design processes. Such facilitated workshops then may focus on identifying user needs and task flows, deriving system requirements, but also creating and evaluating (if often sketchy) design solutions (Gaffney, 1999c; Nielsen, 1993, Gordon, 2002; Kuniavsky, 2003a)⁷⁵. Major benefits include that participatory design methods:

- foster collaboration between, and mutual learning from, users, designers, & developers
- ensure solid solutions that meet the functional needs of end users
- improve acceptance and adoption of the system, and buy-in from end users
- allow for equal participation of technical and non-technical participants
- are very productive
- are easy to conduct

(Gaffney, 1999c; Kuniavsky, 2003a; Nielsen, 1993; Rosson & Carroll, 2002; Rubin, 1994)

Potential shortcomings pertain especially to the overall design philosophy:

- Users may adapt to the team’s way of thinking, which reduces the value of their input
- Users might withhold too negative criticism to avoid admonishing their colleagues
- Users are not necessarily good designers, and cannot account for all design constraints
- Involving user representatives instead of real users might lead to false conclusions
- May miss key success factors, e.g., brand image / economic constraints of production

(Kuniavsky, 2003a; Nielsen, 1993; Rubin, 1994)

Prototyping

A prototype can be defined as “a concrete but partial implementation of a system design” (Rosson & Carroll, 2002, p. 198), in order to save time and costs related to making design ideas more palpable. Prototypes are typically used as a tool to:

- identify and refine user requirements,

⁷⁵ Detailed descriptions and variants of the basic techniques have been provided by Lafrenière (“CUTA”; 1996); Muller (“CARD”; 1993); Muller, Wildman, and White (“PICTIVE”; 1993).

- encourage and investigate new design ideas with the team,
- collaborate with potential users on the design (see participatory design, above)
- evaluate a specific system design with potential users (see usability testing, below)
- share or deploy early implementation efforts,
- document the final design and communicate it to developers

(Rosson & Carroll, 2002; Nielsen, 1993; Liu, 1997; ISO 13407, 1999; Preece, 1993)

Focus and scope of a prototype can be defined in terms of its (1) level of interactivity, (2) degree of fidelity, and (3) the medium it is presented in:

(1) The *level of interactivity* refers to the degree to which a prototype provides functionality and shows behaviors of the real system. In a *horizontal* (or static) prototype, operational features may be present on a top layer, but no action/reaction cycles can be triggered by the user. Thus, horizontal prototypes are especially suited for assessing user's high-level goals and action plans, and the overall appeal of the product. Conversely, a *vertical* (or automated) prototype allows users to take actions that cause state changes in the prototype, if however, maybe only for a narrowly selected set of features. For this limited set, the system thus can be tested in depth; accordingly, vertical prototypes are useful when a few tasks are critical to a system's success (see Figure 2-20; Nielsen, 1993; Preece, 1993; Liu, 1997; Farnum, 2002; Rosson & Carroll, 2002).

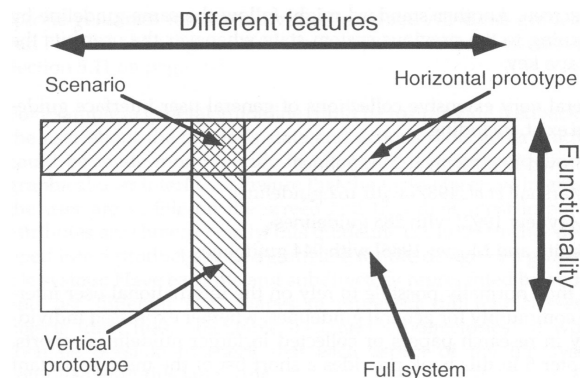


Figure 2-20: Horizontal vs. vertical prototyping (Nielsen, 1993, p. 94)

(2) The *degree of fidelity* refers to how close the prototype is to the final system in terms of its sensory appearance. *Low fidelity* prototypes may involve hand-drawn sketches and rough approximations of basic screen elements, while *high fidelity* prototypes present a close approximation of the actual interface with screen-quality graphics. Accordingly, *medium fidelity* prototypes include some visual design and an average level of detail, as typical for most IA wireframes (see 2.1.5.4; Farnum, 2002, Rosson & Carroll, 2002).

(3) Finally, the *medium* in which the prototype is presented may vary between paper, video or computer (Farnum, 2002; Daly-Jones et al., 1999; see Appendix A-2).

Appendix A-2 provides an overview on prototype variants, which result from a combination of these three variables, together with respective benefits and shortcomings.

Usability Inspection Methods

The term *usability inspection* describes a set of methods also referred to as expert-based evaluations of a product, as their common denominator is the idea that “usability experts examine or work with a system in an effort to detect potential usability problems” (Rosson & Carroll, 2002, p. 234; see also Nielsen & Mack, 1994). Typical examples of inspection methods include heuristic evaluation and cognitive walkthrough.

A *heuristic evaluation* “involves having a small set of evaluators examine the interface and judge its compliance with recognized usability principles [the so-called heuristics]” (Nielsen, 1993, p. 155), in order to identify and resolve potential usability problems (see also Nielsen, 1994; Mayhew, 1999; Rubin, 1994; Daly-Jones et al., 1999). Heuristics can be derived from research and human factors literature (Rubin, 1994). A typical list of heuristics has been introduced by Molich and Nielsen (1990; see Table 2-13; see also Nielsen, 1993; 1994).

In a typical heuristic evaluation, each evaluator (Nielsen, 1994, suggests a minimum of three) separately inspects the system, noting down where and which usability principles are violated. Only after each is through, results are aggregated, discussed and rated according to severity of each problem in real use (i.e., its frequency, impact, and persistence). The output of a heuristic evaluation is thus an annotated list of weighted, potential usability problems (Nielsen, 1993).

Table 2-13: Ten usability heuristics

#	Usability heuristic
1	Use simple and natural dialogue
2	Speak the users' language
3	Minimize the users' memory load
4	Be consistent
5	Provide adequate feedback
6	Provide clearly marked exits
7	Provide shortcuts
8	Give precise and constructive error messages
9	Prevent errors
10	Provide adequate help and documentation

Note. Source: Molich & Nielsen, 1990.

The major benefit of heuristic evaluations, as with most inspection methods, is high cost-efficiency (Nielsen, 1993, p. 32, contends a 1:48 cost-benefit ratio). Further benefits include:

- They are easy to perform, and thus, well suited for “discount usability engineering”⁷⁶
- They can be performed early on in the design process, e.g. with paper prototypes
- Results of heuristic evaluations may spark off ideas for how to improve the system
- They yield a good estimate for how much the system can be improved
- They can guide subsequent testing with users
- They help to ensure compatibility with other equally approved systems

(Nielsen, 1993; Karat, 1994; Daly-Jones et al., 1999; Mayhew, 1999; Rosson & Carroll, 2002)

A major downside to heuristic evaluations, however, is that they primarily uncover problems that are rather easy to identify, while deeply hidden problems may stay unrevealed. Thus, heuristic evaluation cannot substitute for testing with real users (Nielsen, 1993; Mayhew, 1999; Daly-Jones et al., 1999). Additional shortcomings include its dependence on the evaluator’s individual expertise in identifying violations of guidelines, its inability to provide a systematic way to resolve the problems identified, and its potentially discouraging effect on designers (Nielsen, 1993; Karat, 1994; Daly-Jones et al., 1999).

A *walkthrough*, in general, is a technique for evaluating a system by “envisioning the user’s route through an early concept or prototype of the product” (Rubin, 1994, p. 22), and noting problems as the interaction proceeds. A *cognitive walkthrough*, as described by Wharton, Riemann, Lewis, and Polson (1994; also Rubin, 1994; Mayhew, 1999), is a review process in which the responsible designer presents the interface to other members of the team or peers, and guides them through actual user tasks, step by step. The analysts then identify potential difficulties and raise concerns about any aspect of the system. The primary focus of a cognitive walkthrough, according to Wharton et al. (1994), is on ease of learning for first-time or infrequent users, rather than effective and efficient expert performance.

Like heuristic evaluation, walkthroughs are very cost-efficient, especially in identifying misconceptions about user task flows, system navigation, wording problems, and inadequate system feedback. Additional benefits of walkthroughs include flexibility in that they can easily adapt to unexpected issues raised during the session, earliness in that they can be performed early to validate design decisions, efficiency in that feedback can be obtained from

⁷⁶ Discount usability engineering is a pragmatic approach to usability engineering, which relies on “methods that are cheap, fast, and easy to use” (Nielsen, 1994, p. 25). For an introduction to the concept of discount usability engineering, see Nielsen, 1993.

several people at once, and effectiveness in suggesting design changes by describing the reasons for single usability problems (Wharton et al., 1994; Maguire, 1998; Gaffney, 2000a).

With respect to shortcomings, walkthroughs are, due to their focus on ease of learning, not well suited for evaluating ease of use, especially for expert usage. Additionally, walkthroughs tend to identify rather specific than generic problems, and may fail to reveal all of the severe deficiencies. Depending on the prototype's level of fidelity and interactivity (see in this chapter above), it may also be difficult for evaluators to simulate real-world use. Finally, results of walkthroughs are rather opinions than objective data, due to their imaginative and speculative nature (Wharton et al., 1994; Maguire, 1998; Gaffney, 2000a).

In sum, usability inspection methods are often preferred to traditional user testing methods because of their high cost-efficiency, associated with reliable and quick results. In addition, they do not require much human factors expertise in data analysis and are appropriate also to address lower-level design trade-offs, and thus, help to improve organizational acceptance of usability efforts as a whole (Karat, 1994; Rosson & Carroll, 2002).

However, inspection methods might call attention to atypical problems; hence fail to identify all critical or deeply hidden issues. Thus, it is hard to keep them focused on specific evaluation objectives. In addition, they hardly deliver quantitative data, rely heavily on the evaluator's individual ability to identify problems, and do not help much in generating design solutions (Karat, 1994; Rosson & Carroll, 2002).

Usability Testing

Broadly defined, usability testing includes any procedure for determining whether specified usability goals have been achieved (Wixon & Wilson, 1997). However, the term usability testing is typically used more narrowly to refer to a process in which representatives of a target audience are employed to evaluate a product's usability by observing them as they interact with the product and perform typical tasks (Nielsen, 1993; Rubin, 1994). In practice, usability testing can vary in terms of focus, degree of formalization, general test design, or the stage of the product development process it is applied to.⁷⁷ Usability testing is frequently combined with a technique called "thinking aloud", which involves the user expressing their thoughts

⁷⁷ Examples for different foci of usability testing include exploratory, assessment, validation or comparison testing (Rubin, 1994; also Levi & Conrad, 2001). Degree of formalization ranges between discount (or opportunistic) usability testing and formal, controlled experiment (Rubin, 1994; Vora, 1998). Examples for overall test design variants include between- vs. within subjects design; (Nielsen, 1993; 1997) and remote vs. on-site testing (Vora, 1998). Finally, usability testing can either be employed within an iterative design process (formative testing) or for assessing the quality of a more finalized product (summative testing; see Nielsen, 1993; Liu, 1997; Vora, 1998)

while solving a task. This enables the usability expert to identify clearly the problems of the interaction between product and user, the expectations users have regarding the product, and the reasons for their actions (Nielsen, 1997). Usability testing yields a number of benefits, a major one being that real users are performing real tasks, allowing for a valid assessment of a product's usability. Other benefits include:

- High cost-efficiency in identifying critical usability problems
- Allows for addressing specific evaluation objectives
- Allows comparison with previous versions, competitor products, or benchmark values
- Effectively generates recommendations for change
- Few human factors expertise required in data analysis
- Allows for high-level guidance of the underlying design process
- Facilitates organizational buy-in to usability efforts

(Virzi, 1992; Nielsen, 1993; Karat, 1994; Maguire, 1998; Daly-Jones et al., 1999)

Potential shortcomings of usability testing include:

- Might be too time-consuming for short-term projects and small-scale design problems
- Interpersonal and human factors skills of the observer are critical in conducting tests
- Validity of results is dependent on how close the overall test setting is to real-life use
- Becomes less cost-efficient the more costly it is to create a realistic context
- Direct observation of users might be obtrusive and change a person's actual behavior
- Data analysis of notes and video tape recordings are time-consuming and mostly have to be done personally by the note taker, which reduces cost-efficiency

(Daly-Jones et al.; Karat, 1994; Maguire, 1998; Nielsen, 1993)

In addition, the cost-efficiency of usability testing is heavily dependent on how many users have to be tested in order to obtain sufficient results. Nielsen and Landauer (1993; Nielsen, 2000; see also Virzi, 1992) have presented a mathematical model that claims five to eight participants being enough to detect about 85% of usability problems, with diminishing returns for every additional participant (see Figure 2-21). However, this view has been challenged by several authors (Hudson, 2001; Spool & Schroeder, 2001; Woolrych & Cockton, 2002). They contend that, in order to arrive at reliable results in *website* usability testing, one might have

to test with much more participants, depending on, for example, the product's degree of complexity⁷⁸, and each participant's individual probability of finding a usability problem.

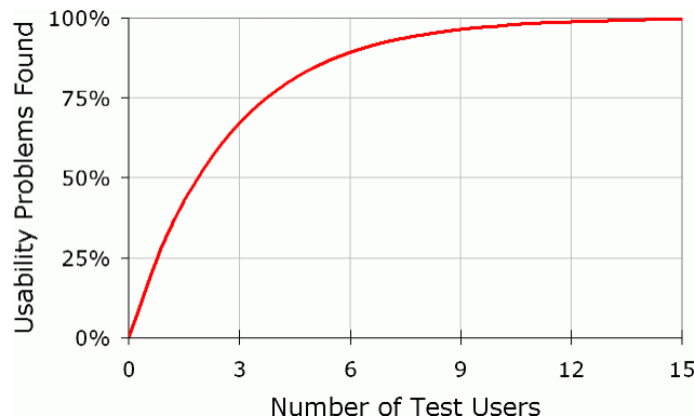


Figure 2-21: Suggested percentage of usability problems found with different numbers of test users (Nielsen, 2000)⁷⁹

2.2.6.2 Excursus: User Interface Design

A *user interface* can be defined as “a computer-mediated means to facilitate communication between human beings or between a human being and an artifact” (Marcus, 2002, p. 24). It may include physical objects, hardware, and software components. The term *User Interface Design* (UID), however, is less clearly defined; basically, there are two main directions:

1. UID in the narrow sense: the activity of creating design solutions: “design of interface elements to facilitate user interaction with functionality” (Garrett, 2000, Web as software interface, ¶ 2; Mayhew, 1999)
2. UID in the broad sense: the process that outputs this interface: “the overall process of designing how a user will be able to interact with a system/site” (The Usability Company, 2003, ¶ 1; see also Marcus, 2002)

In the narrow sense, UID fits well into the overall User Experience model (see Figure 2-13 on page 44) and the process of Usability Engineering (see Table 2-11) as the creative stage. In the broad sense, UID is similar to the overall UE process if applied to the development of computer interfaces, as in Mayhew (1999). In this thesis, however, the term Usability Engineering is preferred to refer to the whole process of developing usable products, while User Interface Design is used in the narrow sense of designing interface elements.

⁷⁸ Complexity, in this context, refers to the amount of data included and the number of choices and possible paths available to users.

⁷⁹ Based on an averaged proportion of usability problems discovered while testing a single user of 31% (Nielsen, 2000).

2.2.6.3 Where Information Architecture and Usability Engineering Meet

The relationship of IA and Usability Engineering has not been an easy one. Library-IAs often tend to draw clear lines between the two disciplines, emphasizing the added value for an information system that only the librarian-based, original IA competencies like classification and organization of information bring (Garrett, 2002; Lou Rosenfeld, interviewed in Rhodes, 1999; see also Dillon, 2002). On the contrary, Interaction-IAs, their practice being more similar to UE and UID, have been trying to explain somewhat more complicated linkages (Vodvarka, 2000; Dillon, 2002; Alison J. Head, as cited in Morrogh, 2003; Lash, 2002a).

Focus

With regard to the focus of the two disciplines, Interaction-IAs contend that, “at the heart of the matter, information architects and usability experts, especially those who work on information resources, have three concerns that bind them together. They are: [1] a focus on users, [2] ease of use, and [3] appropriate, accessible content” (Alison J. Head, as cited in Morrogh, 2003, p. 159). Hence, information architects, just like usability professionals, can be viewed as user advocates in the development process of information systems (Jesse J. Garrett, interviewed in Evans, 2002; Dillon, 2002). However, information architects do address additional questions compared to usability experts; they are much more concerned with information per se, its inherent characteristics, and how these can be leveraged to organize the information (Dillon, 2002; Alison J. Head, interviewed in Rhodes, 2001b). Especially Library-IAs also claim special experience, skills, and focus in handling users’ changing information needs (Lou Rosenfeld, interviewed in Rhodes, 1999).

Goals and Metrics

Whatever flavor of IA one might argue for, all of them agree on the fact that virtually every aspect of the IA system is critical to a system’s usability: with a high-quality IA system, end users are more likely to find the information they need in a shorter time with more ease and satisfaction (Lou Rosenfeld, as cited in Rhodes, 1999; Alison J. Head, as cited in Rhodes, 2001b; Vodvarka, 2000; Rosenfeld & Morville, 2002; Burke, 2002; Lash, 2002a; Forsman, 2003).⁸⁰ However, some modes of information finding, e.g., exploratory gathering of information or “berry picking” (Bates, 1989), which have not necessarily a definite goal or end state, do not lend themselves very well to be evaluated in usability terms (Toub, 2000; see also 2.3.5.3, caveat #4). Besides, an IA system might be aimed at additional goals other than improving

⁸⁰ For a detailed list of benefits of IA efforts for end users, see 2.1.6.2.

usability (e.g., to persuade or surprise the user; Garrett, 2002). Thus, usability measures cannot account for all aspects of the overall quality of an IA system. However, as Toub (2000, p. 9) concedes, in turn, “evaluating the usability of - or a user’s experience with - a web site [also] involves more than IA”, e.g., accessibility issues (see also Lash, 2002a). Thus, with respect to goals and metrics, IA and UE both are just one element of each other.

Process

With regard to the underlying process, IA and UE both share many process steps, from user research in the early stages to usability testing at the end (see 2.1.4 and 2.2.6.1 on respective process descriptions). However, some information architects claim that there is a difference in that the essence of IA processes is creating a solution (the IA system), while researching user needs and testing for usability, main focus of UE processes, are necessary, but each not sufficient ingredients of IA efforts (Garrett, 2002).

Role

In practice, responsibility for IA tasks is assigned to people in various roles (Garrett, 2002). Thus, some argue that “information architect” per se is not a separate role, but rather a set of methodologies performed by web designers, developers, or usability engineers (e.g., Jeffrey Veen, interviewed in Evans, 2002). The larger the project however, the more likely a distinct information architect is needed (Garrett, 2002). Especially Library-IAs call for a separate role of the IA, a unique combination of expertise on organizational theory, technical aspects, and human factors (Dillon, 2002).

Methods

As IA and UE overlap in process, so do information architects frequently make use of UE and UCD methods; but again, especially Library-IAs also rely on methods not well known to and not used by usability engineers, e.g., controlled vocabulary construction (Lou Rosenfeld, interviewed in Rhodes, 1999; Vodvarka, 2000; Dillon, 2002; Jeffrey Veen, interviewed in Evans, 2002; Garrett, 2002).

To conclude, the relationship between IA and UE is defined on multiple dimensions. Whether both should remain separate is still a matter of debate (Garrett, 2002; Dillon, 2002). Garrett (2002) insists that usability research cannot substitute for IA as a discipline, especially because of its lack of addressing the creative challenges of developing an IA system (see also Toub, 2000). However, a strict separation seems not to be very promising: as Dillon (2002) points out, lessons from the past show that, for example, the separation of UE and UID activities has hampered efficient software development. Even if IA and UE as disciplines are not

easy to align, in practice they belong together like “Peanut Butter and Jelly” (Vodvarka, 2000, p. 8), or as Dillon (2002, p. 823; see also Morville, 1999) puts it:

The division between IA and usability is [...] a historical hiccup, a leftover of 20th-century thinking that failed to grasp the fundamental integration of the technologies of information in the lives of 21st-century citizens. I believe that although some will continue to press for the division, such a perspective will prove to be a degenerative paradigm that will be an oddity to scholars and practitioners in 20 years.

2.2.7 Content Management

2.2.7.1 Basics of Content Management

Content Management (CM) can be defined as “the rules (e.g., policies, procedures, standards), roles (people who perform the management), and resources (e.g., time, money, software) used to author, evaluate, organize, publish, maintain and store content objects for a site” (Hagedorn, 2000, p. 3). Boiko (2002, p. 66) focuses on core tasks and defines Content Management as “an overall process for collecting, managing, and publishing content to any outlet”, which emphasizes the fact that CM is not limited to any other specific media. Rather, the promise of CM is to separate content from its presentation and thus to allow for multiple use of the same content components in different publication formats, e.g., in websites, printable documents, and e-mail newsletters (Widerberg, 2003; Boiko, 2002). In line with Boiko’s definition of core tasks, a *Content Management System* (CMS) can be defined as “a system that collects, manages, and publishes information and functionality” (Boiko, 2002, p. 81). It includes hardware and software, but also the content and the processes used to manage it. Such systems “allow content, and thus data, to be archived, retrieved, edited, updated, controlled and made available in different ways, thereby reducing the incremental cost of each update cycle and additional production” (Galano, 2000, p. 9). The basic process for implementing such a Content Management System is presented in Table 2-14.

Table 2-14: Basic Content Management System implementation process

Basic Content Management System implementation process	
1. Business justification	
a.	Assess readiness: identifying existing project mandate, targeted audiences, planned publications, and required content / system
b.	Get a project mandate: building a consensus regarding these issues and the project mandate
2. Requirements Gathering	
a.	Gather requirements
i.	Content requirements (kinds of content to be managed, how it must be gathered & organized),
ii.	Publication requirements (the kinds and structure of outputs of the CMS), and
iii.	CMS requirements (how the CMS hardware and software are required to operate)

b. Do logical design: translate requirements into a platform-independent CMS solution, including the processes to collect, manage, and publish content; relationships between significant players involved in the CMS; and the structure of information and metadata needed
i. Audience analysis: specifying the target audiences for the publications
ii. Publication design: specifying content and navigation of each publication and how each is automatically built and personalized by the CMS
iii. Component design: specifying the complete set of content components to be managed, and how each will be constructed.
iv. Author analysis: specifying content authors needed and how the CMS will serve them
v. Source analysis: specifying from where to acquire information needed for publications and how it will be processed to make it ready for the CMS
vi. Access structure design: Specifying hierarchies and other access structures to keep content organized in its repository and to produce the navigation in publications
vii. Workflow and staffing design: specifying the kinds and numbers of jobs and tasks that will be needed to start up and run the CMS
3. Design
a. Select hardware & software for the CMS
b. Plan implementation
4. Implementation
a. Implement the system:
i. Prepare system specifications
ii. Install and configuring the system
iii. Code templates & applications
iv. Integrate the CMS with other systems
v. Test the system & publications
b. Process content:
i. Develop a content inventory and a processing specification
ii. Acquire & aggregate content
iii. Convert format and structure of existing content into the format and structure needed for the CMS
5. Deployment
a. Load and test content & publications
b. Deploy the CMS: install and test the CMS in its production environment
6. Maintenance
a. Train Staff (including generic training on content management, localization & CMS deployment; specific training for authors, content processors, CMS administrators, page and page template developers)
b. Perform Maintenance: technical administration of the CMS and content maintenance

Note. Sources: Boiko, 2002; Galano, 2000; Schaeffer, 2001; Warren, 2001; Widerberg, 2003.

2.2.7.2 Where Information Architecture and Content Management Meet

As Rosenfeld and Morville note, CM and IA “are really two sides of the same coin. IA portrays a ‘snapshot’ or spatial view of an information system, while CM describes a temporal view by showing how information should flow into, around, and out of that same system over time“ (Rosenfeld & Morville, 2002, p. 11).

Information Architecture, therefore, contributes its spatial view of how content is structured, accessed, and displayed to CM, applied both to the content within the CMS as well as to every publication that emanates from it (Svec, 2000; Boiko, 2002). Information architects both support the implementation of the CMS as well as the ongoing CM process (Warren, 2001; Boiko, 2002). In a typical CMS implementation project, an information architect might act as content analyst, responsible for or involved in tasks described in Table 2-15 for steps

2.a through 5 of the overall CMS implementation process. In ongoing CM processes (i.e., step 6 of the implementation process: Maintenance), information architects can act as *metators* (Boiko, 2002; Warren, 2001): just like editors review and revise an author's work for style, usage, and grammar in accordance with corporate standards, metators fit new content into the prescribed metadata system (see Table 2-15; Boiko, 2002; Reiss, 2000; Warren, 2001).

Table 2-15: Tasks that an information architect is responsible for or involved in during a CMS implementation process (steps 2 through 5) and ongoing content management processes (step 6)

CMS process step	Tasks which an IA is responsible for or involved in
2.a. Gather Requirements	<ul style="list-style-type: none"> Gathering content-related requirements Reviewing and auditing the requirements as they are developed Aligning content requirements with overall requirements
2.b. Logical design	<ul style="list-style-type: none"> Architecting workflow processes used to collect, manage, and publish content. Creating staffing estimates and plans Defining relationships between significant players within the CMS Organizing content requirements into a cohesive content model, ensuring that content can be adequately rendered in the intended publications
3. Design	<ul style="list-style-type: none"> translating logical into physical design of hard- and software implementation Planning the architecture and the organization behind localization. Validating other team members' designs (database models, user interface) and playing a role as "interpreter"
4. Implementation	<ul style="list-style-type: none"> Consulting the team in developing the CMS Architecting processes for content conversion into adequate formats Adjusting the content model specifications as necessary Testing the system at alpha and beta stages Developing documentation for users of the CMS (authors, editors, quality assurance specialists)
5. Deployment	<ul style="list-style-type: none"> Educating CMS users to leverage the CMS's power
6. Maintenance (= ongoing content management processes)	<ul style="list-style-type: none"> Verifying the application of metadata tagged by author and editor Completing missing metadata Reviewing content conversion output with regard to how content components are split up and tagged with metadata Educating authors and editors on tagging content with metadata Distributing and updating the metadata application guide Integrating changes to the content model

Note. Sources: Boiko, 2002; Reiss, 2000; Warren, 2001.

Thus, information architects do have much to contribute to content management; vice versa, CM obviously play a crucial role in implementing content in a way as to satisfy end user informational needs, and thus, the success of an IA system design and hence of the overall information system relies heavily on CM processes and systems: as Nielsen (1999; 1999a) points out, the cost of a single poorly written headline on an intranet home page might amount for a company with 10,000 employees to almost \$5,000 (see also Svec, 2000; Vodvarka, 2000; Baker, 2002; Rosenfeld & Morville, 2002).⁸¹

⁸¹ For more on implications of poor content management for a website's success, see 2.3.3.

2.2.8 Conclusion on Information Architecture and Related Disciplines

The previous chapters show how closely related disciplines are within the context of information system design. The disputes about definitions and responsibilities have long impeded the thriving of the overall field of information system design, and led to much confusion and frustration among professionals as well as clients. The seemingly irresolvable and circular nature of the discussion has prompted some experts to reject it entirely as purely academic and pointless: “I find the hoopla around the terms to be not only a distraction but a waste of time” (Nathan Shedroff, interviewed in Mazur, 2001, p. 6; see also Richard S. Wurman, interviewed in Mazur, 2001). In their view, the work done by the professionals and the questions that arise during their work matter much more than discussions about job titles.

However, the discussions are not about terms only. Clear-cut definitions and coherent descriptions of disciplines, processes, and roles involved are essential for the whole industry domain of information system design to improve its practice and deliverables, to advance intra- and interdisciplinary communication, and to promote an adequate understanding of the field in clients’ minds in order to increase recognition and gain market share. Facing this need for a coherent and consistent description of the field, it is, first of all, necessary to admit that even if there are large areas of overlap between any two discipline related to information system design, each of these disciplines has a unique focus with unique issues addressed and methods used, and therefore cannot be substituted by another. Thus, boundaries may be fuzzy, and “the lines [may] get crossed every day” (Rosenfeld & Morville, 2002 p. 108), but each of the disciplines revolves around a distinct and independent core.

Defining disciplines by their core, and then forthrightly outlining areas of overlap with other disciplines, seems to be a promising approach in building towards a collective understanding of the discipline of IA, as well as the overall field of information system design. Although the field has made progress in that direction, and the use of terms gradually begins to show some consistency, it is still a long way for the discipline of IA to arrive at a stage of maturity. Until then, it is vital for IA to acknowledge the “right of existence” of other disciplines, draw from their knowledge and expertise and thus, to further advance its school of thought and the interdisciplinary practice of architecting information (Morville, 1999; Garrett, 2002; Rosenfeld & Morville, 2002).

2.3 Web-Specific Deficiencies from an End User Perspective

2.3.1 Introduction

Whatever approach and process in designing a website is taken and whatever methods and techniques are used, the overall goal for any website development project is to establish a successful communication channel, be it in terms of e-commerce, education, information, entertainment, or other purposes. As explained in Chapter 1, on the web, more than in traditional media, success is largely determined by a website's usability, i.e., the degree to which users can achieve their goals with effectiveness, efficiency, and satisfaction (see 2.2.6.1). However, even today, after more than 10 years of WWW evolution, interacting with a website still can be a tremendously frustrating experience for end users (see for example, Charny, 2000; Ojakaar & Spool, 2001).

Many website deficiencies contributing to this frustration are not exclusive to the web, but involve universal user interface design problems: inconsistencies in the course of interaction, low visual contrast between screen elements, idle help messages, to name a few.⁸² However, the web also poses unique challenges on the design of successful information systems, due to its inherent conceptual and technological nature. In the following, symptoms of these web-specific deficiencies are presented and subsequently traced back to deeper root causes. Both are then illustrated with exemplary results from a comprehensive usability study evaluating an intranet website for employees of the Siemens AG. Finally, consequences resulting from these deficits are identified that apply to users as well as the organization that owns the website.

2.3.2 Symptoms of Web-Specific Deficiencies

2.3.2.1 The Web as an Information Space

The sum of websites a user of the WWW faces today amounts to an information corpus "whose size is unprecedented" (Zeiliger, 1998 p. 93; see also Rosenfeld & Morville, 2002; Abrams & Baecker, 1997; Carroll, 1999): by October 2004, there were more than 55 million websites on the World Wide Web ("Netcraft Web Server Survey", 2004), containing an estimated 170 terabyte of information already in 2002 (Lyman & Varian, 2003)⁸³; the popular

⁸² These deficiencies of software interfaces of any kind are covered in detail by the ISO 9241 standard on usability and dialogue principles, and they have been extensively described in the literature (for an overview, see Nielsen, 1993; Shneiderman, 1998).

⁸³ 1 terabyte = 10^{12} bytes

web search engine Google.com listed more than 4.2 billion pages in its directory and served more than 81.9 unique users per month (“Google Corporate Information”, 2004). In the future, these figures very likely will continue to increase. This is essentially what Morrogh (2003, p. 97) calls “info glut”: simply too much information for a human to cope with.

The web not only allows for instant access to myriads of websites, but also provides an easy and cheap way to disseminate information unparalleled in history. In the past, monetary, temporal, and other costs of publishing information ensured that information was carefully reviewed prior to publication by journalists, editors, publishers, and other professionals. Today, however, it literally takes just one click to make information accessible to millions of internet users. As a result, there are no unified writing processes or standards, and the web is polluted with shallow, unclear, redundant, biased, outdated, and erroneous information, or “info trash” (Morrogh, 2003, p. 99; see also Abrams & Baecker, 1997; Zeiliger, 1998).

The decentralized and open nature of web publishing also implies that the development of its inherent structure has not been coordinated and controlled by any central and authoritative instance, as is the case in traditional media (e.g., libraries for books). As a result, no global view of this structure is available to users (Abrams & Baecker, 1997; Cockburn & Jones, 1997; Furnas, 1997; Zeiliger, 1998). Along with this ease of publication also comes the fact that the web is a constantly changing medium: not only is new information published every day, but previously available material is deleted or changed, links are established, changed, or removed, and thus, the web “progresses toward disorder according to the principle of [...] entropy” (Abrams & Baecker, 1997, ¶ 8).

2.3.2.2 Navigating the Web

In an information-abound medium like the web, finding relevant information is one of the most frequent and important tasks for users: whether one wants to buy something, be informed, or communicate, a major part of the time expended is spent on collecting, filtering, and selecting information, looking for the answer to a specific question (Vora, 1998; Rosenfeld & Morville, 2002; Lee, 1999; Kosala & Blockeel, 2000; Morville, 2002). On the web, people seek information using two major modes of access: browsing via links or searching by entering a query (Hagedorn, 2000; Rosenfeld & Morville, 2002; Choo, Detlor, & Turnbull, 2000).⁸⁴ Both modes present specific challenges to the user, as described below.

⁸⁴ As outlined in Footnote 29 on Page 19, the terminology widely used for IA system components and user activities performed on them is inconsistent. In line with the available literature, in this thesis, the user activity of

Browsing a Website

Browsing can be defined as “the process of users following paths through a site that results in the retrieval of specific content objects” (Hagedorn, 2000, p. 2). While browsing a website, users can rely either on the links delivered by the website, or mechanisms built in the web browser, software that displays a website’s pages (e.g., Microsoft’s Internet Explorer or Netscape Navigator). Common functionalities of a browser for traversing a website include “back”- and “forward”-buttons, history-lists, and bookmarks.

The *Back*-button allows for movements within a “stack” of previously accessed pages. Once descended into lower levels of the current stack, the *Forward*-button lets the user ascend within the stack again. However, every time a new link is selected, all the pages in the stack above the current position are deleted, and the new page is added on top (Cockburn & Jones, 1997; Lee, 1999). This behavior is different from a purely linear, time-based record of visited pages, which would maintain all pages and put the new on top of a time-based sequence of pages. Most users seem to be not aware of this stack-model, and thus are substantially confused and frustrated, e.g. because of lost pages they cannot retrace (Cockburn & Jones, 1996; 1997; Lee, 1999; Snyder, 2001). Research indicates that a simple recency-based mechanism, with doubled entries removed, would better support re-access of previously visited pages (e.g., Cockburn & Jones, 1997). An example for such a time-dependent storage of previously accessed web sites is the *History*-function of Microsoft’s Internet Explorer.

Bookmarks (or favorites) allow the user to store single URLs for later re-access. To users, bookmarks are an essential browser feature, with 84% using them regularly (Abrams & Baecker, 1997; Brown, B., & Sellen, 2001; Cockburn & Jones, 1997). Complications however arise when it comes to managing bookmark entries, as for example it involves considerable effort to organize the list of URLs in a meaningful folder structure (Brown, B., & Sellen, 2001).

Ultimately, these features are supposed to support the user’s browsing activities within a site’s given structure. Spool, Scanlon, Schroeder, & Snyder (1999) found that, when traversing this structure, users apparently do not form a mental representation of the site’s structure, and thus, it would be naïve to assume users easily can adapt to any structure after a while. On the contrary, users frequently encounter problems regarding the navigation of a site’s struc-

searching a website is subsumed with *browsing* under the act of *navigating* a website; however, for IA system components, a *search system* supporting user searching is treated as distinct component next to *navigation systems*, which enable browsing activities (see 2.1.3.1).

ture: they have a hard time determining where they are, where they have been, and where they can go (e.g., Conklin, 1987). According to Spool et al. (1999), these problems can be traced back to two major reasons:

- The user has little domain knowledge to understand the site's structure
- The structure does not meet the user's expectations

Little domain knowledge: Ojakaar and Spool (2001) argue that the more users are familiar with the language used in the knowledge domain of the website, the easier it is for them to browse its navigation hierarchy. They propose that, to measure this familiarity across different users, it is necessary to assess the level of agreement between user with regard to the labels for top-level categories of a website (e.g., do all users call the category for recently published books on www.amazon.com “new releases” or do they disagree in labeling it?). To help users in complex domains with low category labeling agreement, they suggest designing explicit categories, explaining categories with additional descriptive terms, and thereby using the most popular trigger words (Ojakaar & Spool, 2001, p. 9). Spool et al. (1999) name two major determinants for the success of labels:

- Predictability: degree to which a given label describes the content associated with it
- Differentiability: degree to which a set of labels are mutually exclusive in their meaning to the user

These characteristics can be assessed using simple brainstorming techniques, in order to identify appropriate trigger and descriptive words (Ojakaar & Spool, 2001; Fuccella & Pizzolato, 1999a; Fuccella, Pizzolato, & Franks, 1999).

Users' expectations: While users might not build up an accurate mental model of the site's actual structure during their visit, they do approach the website with preconceived perceptions of how the site is structured, stemming for example from previous experiences with competitors' websites. If these expectations are not met, users are less likely to select the appropriate categories and find what they need (Spool et al., 1999; see also 2.1.2.5). User expectations regarding the site's structure can be identified using card-sorting techniques and its variants (see 2.1.5.2). To account for disparate expectations, Ojakaar and Spool (2001) suggest putting subcategories in more than one place of a hierarchy.

A great deal of research has been dedicated to how information is optimally organized in a hierarchy for access through digital interfaces (for an overview, see Larson & Czerwinski, 1998; Zaphiris & Mtei, 1997). As described in 2.1.2.5, a common but ultimately flawed rule of thumb of “about 7+/-2 items per hierarchy level” can be traced back to George A. Miller's

study on short memory span in the 1950s (Miller, 1956). Research that is more recent points to a much more complex picture; results indicate that:

- users' decision time per level increases with breadth
- users' overall task response time increases with depth
- users' failure rate increases with depth; however, this is not supported by all studies
- users' feeling of lostness increases with depth
- users perceive a task to be more complex with deep structures and prefer shallow ones
- the more ambivalent users perceive labels, the worse perform deep structures; with no ambivalence, a deep structure yields better results regarding task time

(Kiger, 1984; Landauer & Nachbar, 1985; Jacko & Salvendy, 1996; Zaphiris & Mtei, 1997; Larson & Czerwinski, 1998; Miller & Remington, 2000)

Thus, there seems to be a complex interaction of many variables at work: broader navigation appears to be associated with higher visual scanning demands per navigation level, while deeper navigation seems to imply additional decision-making, response selection, and uncertainty (Jacko & Salvendy, 1996). As shown by Miller and Remington (2000), the question of deep or broad navigation menus cannot be answered without accounting for other variables, e.g., ambivalence of navigation item labels. In addition, visual scanning ability is highly dependent on a page's information and visual design (e.g., Nielsen, 1999). However, information and visual design is something that is in control of and can be optimized by the website's designer; ambivalence of labels for users can never be ruled out completely, and the additional burden of making decisions with every new level cannot be eliminated. Hence, in doubt, it seems reasonable to opt for shallow and broad rather than deep structures (Snowberry, Parkinson, & Sisson, 1983; Landauer & Nachbar, 1985, Larson & Czerwinski, 1998; Tiller & Green, 1999).

It remains, however, that page-level organization of information, and thus the layout of single pages is a major determinant of a website's success, and a key element of its IA system. Although not specific to the web, layout is thus included in the subsequent analysis of web-specific deficiencies as a major factor in organizing information.

Searching a Website

Searching, in the context of interacting with a website, describes the "process of users entering terms into a system that results in a selection of content objects" (Hagedorn, 2000, p. 6). This includes searching the whole internet using search engines like Google, Altavista, and

Yahoo⁸⁵, as well as using a website's integrated search functionality to search within the site's corpus of information.

With regard to the former, Charny (2000), reporting on a study conducted by Roper Starch Worldwide, contends that “nearly a third of Web users say they need to spend about two hours a week searching” (Charny, 2000), with a majority (71%) of them said to become frustrated using a search engine, regardless of whether the search turns out to be successful or not. With regard to the latter, Ojakaar and Spool (2001) report up to 70% unsuccessful searches on websites; Nielsen (2001) claims that when users aren't successful with their first query, almost 50% give up immediately, and for those who continue, the chance of success deteriorates with every reformulation of the query (first query: 51% rate of search success; second: 32%, third: 18%; see also Nielsen, 1997b). It has been argued that a major segment of web users is search-dominant, i.e., when arriving at a website, they always use the search functionality instead of browsing category links (Nielsen, 1997b: more than 50% of all users; Spool et al., 1999: 33%). However, recent studies conducted by Ojakaar and Spool (2001) show that, instead of some users always preferring search, it seems that rather a portion of websites (21%) is always navigated using the search functionality by *all* users, while other websites are browsed by almost all of them. This seems to be a result of how well the categories on the homepage of the website meet user expectations and include important trigger words: the more users feel confident with the labels presented, the less likely they turn to the search functionality; only when the categories do not promise to alleviate their informational needs, the search is consulted (Ojakaar & Spool, 2001).

A search system exhibits idiosyncratic deficiencies with regard to how well users can interact with it. These deficiencies are related to three major issues, being query formulation, search engine performance, and results display.

Query formulation: As Pollock and Hockley (1997; see also Ojakaar & Spool, 2001) point out, for novice users, formulating adequate search queries can be difficult even when they have all the information required to do so. Thus, in their study, participants used natural language to express informational needs rather than keywords, tried to express several searches simultaneously, and over- or under-specified search queries (Pollock & Hockley, 1997). A major technical obstacle to successful searching is the inflexibility of many search engines regarding misspellings in and synonym expansion of a user's query input (Nielsen, 1997b; Charny, 2000; Hagan, Manning, & Paul, 2000; Ojakaar & Spool, 2001). Hagan et al. (2000)

⁸⁵ For an overview, see www.searchenginewatch.com.

found that 71% of website search engines fail completely to account for these issues (with another 23% failing mostly), although, as Charny (2000, ¶ 10) notes, people use for example “dozens of different spellings of ‘HotMail’” with Microsoft’s MSN homepage search engine. As mentioned in 2.1.3.2, in these cases, a simple controlled vocabulary could be used to automatically substitute misspelled query terms or expand a query to include synonyms of the search term, resulting in a more adequate result set.

Additional search options, like for example scoped or fielded search⁸⁶, while empowering the expert to form detailed queries, seem to potentially harm the success of search, as especially novice users might misunderstand or oversee the functionality (Nielsen, 1997b; 2001a; Shneiderman, Byrd, & Croft, 1997; Schulz, 2000). Nielsen (1997b, 2001a) therefore suggest to either avoid scoped search or, if implemented, to set the default to “search entire website”, and to explicitly state what subsite is being searched and how to enlarge or narrow the scope.

Another advanced search mode is the use of operators. Nielsen (1997b, ¶ 9; see also Nielsen, 2001; Ojakaar & Spool, 2001), with regard to Boolean operators⁸⁷ in web query construction, contends, “all experience shows that users cannot use it correctly”. Rates for incorrect use of Boolean operators have been shown to range between 26.3% (“AND”) and 65.83% (“AND NOT”; Jansen, Spink, & Saracevic, 1998). Modifying operators, including “+”, “-”, and inverted commas⁸⁸, were used incorrectly up to 97.42% of all searches (“-”).⁸⁹ As in addition, operators are used only very rarely by internet users⁹⁰, they should thus be featured prominently only on an “advanced search” page (Nielsen, 1997b).

Search engine performance: Two of the most frequently encountered problems in searching are zero hits and too many (irrelevant) hits, obscuring the few relevant ones. Zero-hit outcomes have been shown to occur on 30% of all web searches (Shneiderman et al., 1997), and 16% of website search engines completely fail to find all relevant content (with another 40% failing mostly; Hagan et al., 2000). In Information Retrieval, this degree of comprehensiveness of the result set is referred to as “recall”: a measure of the coverage of a document set

⁸⁶ *Scoped search* (also search zones): restricting a search to a specific subsite of the whole website (Nielsen, 1997b, Rosenfeld & Morville, 2002); *fielded search*: limiting a keyword search to a subset of the overall content defined by a certain attribute, e.g., author name: “only books written by Michael Crichton” (Rosenfeld & Morville, 2002).

⁸⁷ Boolean operators include “AND”, “OR”, “AND NOT”, and nesting through brackets.

⁸⁸ Modifying operators: a “+” before a term in a search query means the word must be in the document searched; a “-” that the word must not be in the document; inverted commas denote an exact phrase to be found.

⁸⁹ Additional figures for incorrect use of operators: Boolean operators: “OR”: 34.85%; use of brackets: 32.23% mistake rate. Modifying operators: use of inverted commas: 7.98%; use of “+”: 55.97% error rate (Jansen et al., 1998).

⁹⁰ Ranging from below 1% (OR, NOT, AND NOT, use of brackets) to 8.68% (“AND”; Jansen et al., 1998)

indicating “how successful the software is in indexing all the documents that possibly relate to a query” (Adams, 2001, ¶ 10). It can be expressed as:

$$\text{Recall} = \frac{(\text{Number of relevant documents retrieved})}{(\text{Total number of relevant documents in system})}$$

(Rosenfeld & Morville, 2002, p. 181)

Another metric used in Information Retrieval research for estimating the quality of a result set is called “precision”: a measure of the accuracy of a document set, specifying “how well the software separates out the irrelevant documents from the genuinely relevant ones” (Adams, 2001, ¶ 10). In a formula, this is:

$$\text{Precision} = \frac{(\text{Number of relevant documents retrieved})}{(\text{Total number of documents retrieved})}$$

(Rosenfeld & Morville, 2002, p. 181)

Schlichting and Nilsen (1996), applying signal-detection theory principles to the performance of web search engines, found overall poor precision figures of popular web search engine like Lycos, Excite, Infoseek, and AltaVista, as they were barely able to discriminate between “good” and “bad” links. More recently, Hagan et al. (2000) found 50% of website search engines to retrieve irrelevant results, confirming their overall low precision.⁹¹

Results display: With the result set typically containing more and less relevant documents, it is crucial in what order search results are displayed to enable quick access to most relevant hits (Nielsen, 2001). According to Hagan et al. (2000), 22% of website search engines fail completely at listing results from most relevant (with 41% failing mostly); 33% totally fall short of presenting results in a “useful” interface (with another 43% mostly). Ojakaar and Spool (2001; see also Schulz, 2000) found that search results displays frequently obscure the rationale behind the search mechanism, and that single results consist of “cryptic, terse descriptions, often taken directly from the HTML title tags” (Ojakaar & Spool, 2001, p. 4). They also discovered that users have more problems with multi-page lists of results than with a single page of results, and thus almost always stick to the first page of a multi-page list, ignoring even the second page of results most of the time (see also Nielsen, 1997b). Nielsen (1997b)

⁹¹ It has to be noted, though, that *relevancy*, as used in the formulas above, is a subjective measure, indicating the pertinence of a document set to a given matter. Thus, both precision and recall figures also rely on subjective criteria.

In addition, recall and precision as metrics for the quality of a result set are inversely related: the more thoroughly a given set of results includes all possibly related documents (high recall), the more likely it also incorporates unrelated documents (low precision), and vice versa (Rosenfeld & Morville, 2002; Adams, 2001).

showed that usability of search results display could be enhanced by presenting results relative to the site's structure, which allows for easy switching between the two modes of navigating (see also Rosenfeld and Morville, 2002; Morville, 2001; Veen, 2002).

In conclusion, Ojakaar and Spool (2001) contend that search systems work efficiently especially on websites whose content lends itself to known-item searching, like for example Amazon.com, where users frequently know at least a book's author or (parts of) the title to use as search phrases. With many websites, though, this is not the case, and users frequently fail at adequate query formulation (Ojakaar & Spool, 2001; Pollock & Hockley, 1997). However, users frequently turn to search as it gives them control over how to navigate the content, and as it acts as an "escape hatch" whenever they get stuck (Nielsen, 2001). Thus, Nielsen concludes, search should be "visible and simple": a simple search box on every single page of the website, relegating advanced search to a secondary page (Nielsen, 1997b; 2001a).

2.3.2.3 Technical Constraints of the Web

As an interactive, computer-mediated communication channel, the web also suffers from technical limits that hard- and software pose on the interaction between user and website, with slow system response time⁹² being the most prominent. Factors determining system response time are multifold, including performance of browser software, speed of the internet connection, amount of local network traffic, load on the remote host, and the characteristics of the web page requested (Nah, 2004), which in sum makes it hard to control for delays in response time. These have been shown to cause user frustration, increase the proportion of users quitting a task, worsen perceived website quality and users' trust, and decrease overall frequency of users re-visiting the website (Selvidge, 1999; Hoxmeyer & DiCesare, 2000; Nielsen, 1997a; Shneiderman, 1998; Brynjolfsson & Smith, 2000; Reaux & Carroll 1996). Sears, Jacko, and Borella (1997) found a striking relationship between system response delays and the website's use of graphics: thus, for text-only websites, longer response delays were associated with *more* favorable responses in terms of content quality, organization, and navigation; whereas for text-and graphic, as expected, websites were rated more favorable the faster they loaded. Other variables mitigating the negative impact of response delays include an overall positive attitude towards the website (Lee, 2000), and the availability of feedback on download progress (Nah, 2004). Older web users, as well as user regularly accessing the web with slower dial-up connections, were found to be more tolerant of response delays (Selvidge,

⁹² System response time: the time between the user's input and the computer's response.

2003). Slow response times were omnipresent in the early days of the web and thus rated by users as their #1 complaint (GVU Center, 1996; see also Sears et al., 1997; Dix, 1998; Lee, 1999), which resulted in the acronym “WWW” often being translated ironically as “world wide wait” (Mayhew, 1998, p. 12). However, despite recent improvements in hardware speed and data communication bandwidth, delays in system response also remain a serious concern today, and likely will be in the future, due to the exponential growth of users and the increasing use of multimedia in ever-more complex websites (Hoxmeyer & DiCesare, 2000; Nielsen, 1997a; Selvidge, 2003).

Other technical constraints stem from the use of HTML, the language employed in coding most of the websites available today.⁹³ Basic HTML provides only a limited range of expressible hypertext features (e.g., does not support typed or bi-directional links) and is unable for example to affect browser status (e.g. the history list; Cockburn & Jones, 1997). Also, interaction mechanisms like drag-and-drop, well-known to users from traditional desktop applications like Microsoft’s Windows, cannot be implemented with traditional, HTML-based websites, and differences between browsers (such as Microsoft’s Internet Explorer and Netscape’s Navigator) in how they interpret HTML and other standards result in some features to be displayed differently or to not work at all, depending on the type of browser in use; this is even true for the latest generation of browsers (IE6 and NN6), which differ significantly in how they interpret the CSS⁹⁴ standard (Cockburn & Jones, 1997; Siegel, 1997; Shannon, 2004; Surveyer, 2004).

A major downside to HTML is that it is merely a markup language, i.e., it hardly conveys any semantic information about the information displayed, but just defines how it is presented. This fundamental flaw of web technology is currently the focus of huge efforts to transform the WWW into a *semantic web*, using for example XML⁹⁵ to implement structural and other metadata pervasively across the web (e.g., Fensel, 2003; see also 2.1.3.2).

Enhancements to basic web technology, such as Shockwave, Java, JavaScript, Flash, or ActiveX elements, actually introduced to remedy some of the problems of basic HTML, and extend web functionality and display capabilities, have raised levels of technical complexity

⁹³ HTML: HyperText Markup Language; uses a set of “markup” codes to define how information included in WWW hypertext documents is to be presented. A minor segment of websites is coded in Macromedia’s Flash, which similarly suffers from idiosyncratic usability problems (Nielsen, 2000a).

⁹⁴ CSS (Cascading Style Sheets) are an extension to HTML, standardized by the World Wide Web Consortium (W3C). CSS provide a specification for designing layout and style elements of a web page.

⁹⁵ XML (eXtensible Mark-up Language): universal format for structured documents and data on the web, developed by the W3C. XML describes information by defining what the data is about.

and intransparency for users, while at the same time users were forced to understand their implications, and eventually handle related problems and security issues (Vora, 1998).

2.3.3 Root Causes for Web-Specific Deficiencies

Five major root causes for users' problems in interacting with websites have been identified:

1. Organization needs trumping user and content needs
2. Inadequate differentiation of responsibilities
3. Weak technology
4. Poorly managed content
5. Inadequate methodologies for designing and organizing information

(Vora, 1998; Nielsen, 1999, 1999a; Hagan et al., 2000; Ojakaar & Spool, 2001; Baker, 2002; Boiko, 2002; Garrett, 2002a; Rosenfeld & Morville, 2002; Wodtke, 2002)

(1) *Organization needs trumping user and content needs*: In the late 1990s, the web euphoria literally forced organizations to rush to the internet, which regularly resulted in user needs not being taken account of (Vora, 1998). While since the end of the web hype, this need is significantly lower (Garrett, 2002a), even today (as of 2004), end users frequently have to put up with websites structured according to the organization's business functions, and navigation elements labeled using corporate jargon (e.g., Rosenfeld & Morville, 2002). Yet all too often, the vital need to invest more expertise than plain "common sense" to build a usable website is disregarded by executives and managers and considered a luxury, and thus, sufficient analysis of user needs and content characteristics, together with well considered design and usability evaluation is sacrificed in favor of a quicker launch of the website (e.g., Nielsen, 1993).

(2) *Inadequate differentiation of responsibilities*: In the early days of the web, too many tasks assigned to one person, from HTML coding and programming to organization of information to interface design to site maintenance, frequently led to a so-called "SuperWebmaster syndrome", which resulted in "compromised design solutions for medium to large-sized Web sites" (Vora, 1998, p. 154). Nowadays, especially in medium and large-scale website projects, responsibilities are much more differentiated, in that the distinct elements of a running website (technical backend, interface, contents, etc.) are taken care of by individual professions. Rather, in today's large-scale web projects, threats to effective and efficient website development rather stem from too fine a fragmentation of responsibilities in web development and maintenance teams, which then run the risk of inefficient collaboration, and thus unsuccessful websites. (Lash, 2002; see Chapter 2.2 on the various disciplines involved in website development, and their interactions).

(3) *Weak technology*: As described in 2.3.2.3, the web's underlying technology poses inherent problems on any website's quality. For example, Hagan et al. (2000) view the technology driving many website search engines as being too unforgiving and aggressive, not allowing for misspellings or synonyms. System response delays, HTML constraints, and browser inconsistencies, as described in 2.3.2.3, are further symptoms of the poor technical realization of the World Wide Web.

(4) *Poorly managed content*: Deficient content management affects the quality of a website in at least three ways, being low quality content per se, low quality contextual browsing, and low quality search results. With regard to the former two, poor content management involves authors and editors of websites being hindered or unwilling to create content relevant in user terms, and keep content and included contextual links up to date (Baker, 2002; Vora, 1998). With regard to the latter, inconsistent tagging, redundant or incoherent titles, and unusable descriptions of the content diminish the quality of search results (Baker, 2002; Hagan et al., 2000).

(5) *Inadequate methodologies for designing and organizing information*: With many websites, users still have to put up with low-quality information and inadequate information structures (see 2.3.2.1 and 2.3.2.2). These symptoms have been repeatedly traced back to the underlying methodologies and guidelines for designing and organizing information during website development; thus, for example, available IA methodologies have been shown to be inadequate and not sufficiently adjustable to given project constraints, and methods from Usability Engineering, while technically available, are not adopted in practice (Nielsen, 1993; Vora, 1998; Garrett, 2002a; Rosenfeld & Morville, 2002; Wodtke, 2002; see also 2.1.4.1).

2.3.4 Case Study: Siemens Employee Portal

In this section, a case study is reported to illustrate the web-specific deficiencies and respective causes described in the previous chapters. The case study is based on results from comprehensive usability tests and inspections conducted on an Employee Portal of the Siemens AG (SEP), a corporate-wide intranet website for employees, from September through December 2001 in three locations: Beijing (China), Munich (Germany), and Princeton (US).

The evaluations included more than 30 participants, and yielded more than 550 individual usability deficits. Tests were conducted according to traditional usability testing procedures (see 2.2.6.1): Participants performed typical tasks using the SEP, verbalizing their thoughts as they went along ("thinking aloud", see 2.2.6.1), while an experimenter observed them, identifying and noting usability problems. In the following, exemplary usability problems are listed

for each of the specific deficiencies of the web as described above⁹⁶, and the proportion of identified (real, case-study derived) problems attributable to each (theoretic, literature-derived) deficiency is given in relation to the overall number of problems.

Some of the individual problems come up in more than one category, which confirms the interrelated, multi-faceted and thus multi-disciplinary character of website development explained in 2.1.7: for example, a menu structure that was considered to be complex by the user, can be both attributed to poor layout (and thus, of poor Information and / or Visual Design⁹⁷) and inadequate information structure (and thus, of a poor IA system).

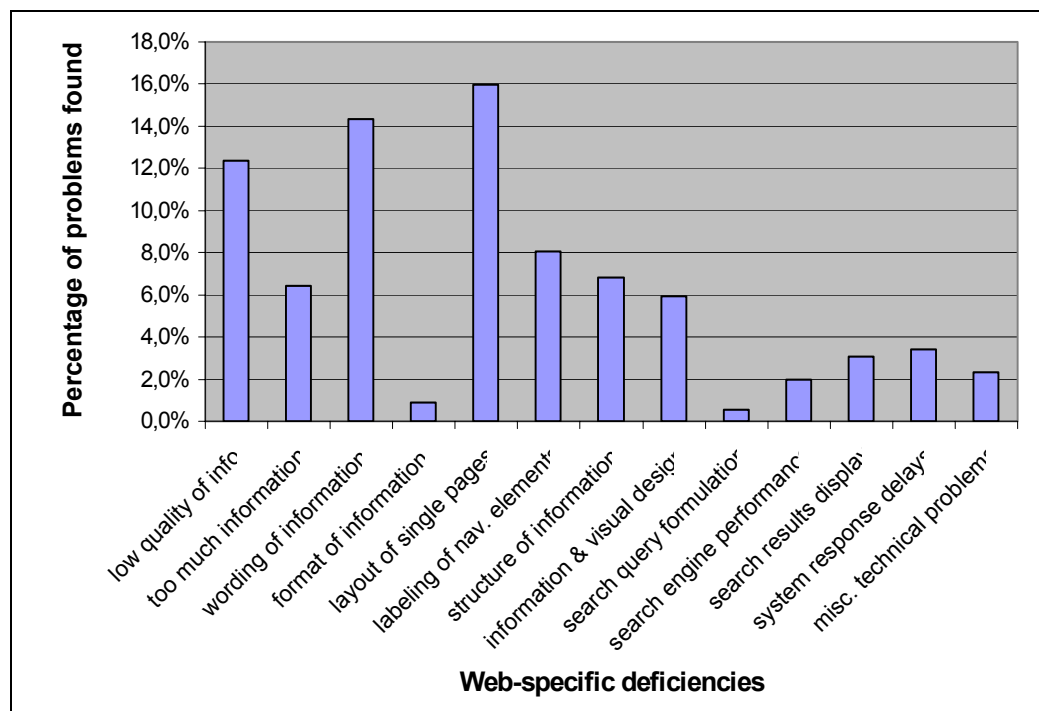


Figure 2-22: Usability problems found in the evaluations of Siemens' Employee Portal⁹⁸

Some of the problems found, however, could not be attributed to one of the web-specific deficiencies listed in chapter 2.3.2. In most cases, these were related to the functionality of the interface and interaction flow (e.g., missing, unwanted, or opaque functionality, unexpected behavior of single functions; for the distinction between interaction flow, interface, and IA, see chapters 2.2.2 and 2.2.6). Overall, 118 such problems were identified (or 21.1% of a total 558 usability deficits found; see Table 2-16).

⁹⁶ While examples include descriptions of usability problems as noted by the usability researchers during test sessions, they partly have been translated from German by the author.

⁹⁷ See 2.2.3 and 2.2.4 for descriptions of the respective disciplines.

⁹⁸ Usability evaluation did not focus on usability of the SEP's search system; figures for search query formulation, search engine performance, and search results display thus do not represent real proportions.

Table 2-16: Exemplary usability problems of the SEP not specific to the web

ID	Usability problem description
UP1-1	Re-clicking an already selected navigation element does not lead to reload
UP1-2	Drop-down menu as an interaction mechanism are not appreciated
UP1-3	After choosing a “delete”-functionality, items are instantly deleted without further check
UP1-4	Unclear how to skip introductory animations
UP1-5	Help-section is expected to but does not operate like Microsoft’s help in MS Word

As explained in 2.3.2, such problems are not specific to the web, i.e., they also occur frequently in any non-web software application, and thus were not focused on in the literature review, nor in the analysis of results of the usability evaluation of the Siemens Employee Portal described hereinafter.

2.3.4.1 The SEP as an Information Space

In sum, 190 single problems of the 558 usability identified were related to characteristics of the information delivered by the SEP, which equals 34.1%. The major proportion (69 problems or 12.4% of all 558 problems) was due to low quality of the information, i.e., redundant, shallow, irrelevant, unclear, inaccurate, out-of-date, erroneous, or biased information (see 2.3.2.1). Typical examples are presented in Table 2-17.

Table 2-17: Exemplary usability problems of the SEP due to low quality of information

ID	Usability problem description
UP2-1	Homepage and a sub-page provide identical information
UP2-2	Descriptions of departments are listed which are no more existent
UP2-3	Help is too unspecific, not detailed enough
UP2-4	Extensive coverage of Infineon, a former sub-entity of Siemens, not needed anymore
UP2-5	Customization feature is explained that in fact is not available

Another 36 instances (6.5%) described cases of too much information, where some information was either generally unwanted or too finely grained (see Table 2-18).

Table 2-18: Exemplary usability problems of the SEP due to too much information

ID	Usability problem description
UP3-1	No need for general newspaper items in the “news” section of the SEP
UP3-2	Page gives information not needed to perform a task
UP3-3	Product description is mostly advertising text, real information hidden underneath
UP3-4	“Welcome”-page has too much text, and users think it is a waste of time
UP3-5	Too much text in the “Philosophie” (mission & vision) section

With regard to the lack of inherent structure of the web, no equivalents were found in the usability test and inspection results, as this deficiency pertains to the web as a whole rather than a single internet or intranet site. Similarly, the dynamic evolvement of the web as a shortcoming could not be identified as the evaluations represent a snapshot of the SEP, and thus cannot

account for changes that happen over time. The major portion of the remaining information-related usability deficits were linked to wording problems (e.g., unclear abbreviations, inaccurate terms; 80 single problems or 14.3%), and a few were due to the format in which the information was presented (e.g., unwanted animations; 5 or .9%).

2.3.4.2 Navigating the SEP

Browsing the SEP

For deficiencies related to browsing the SEP, the evaluation brought up 205 usability problems, equaling 36.7% of all deficits found. The majority of these problems were related to layout of single pages (89 occurrences, or 15.9% of all usability problems; see Table 2-19).

Table 2-19: Exemplary usability problems of the SEP due to suboptimal layout of pages

ID	Usability problem description
UP4-1	Visual separation of distinct page elements not sufficient
UP4-2	Complex appearance of pages
UP4-3	Pages not well structured
UP4-4	Too much white space on pages
UP4-5	Related page elements not grouped together

Forty-five deficits (8.1%) were due to poor labeling of navigation elements (Table 2-20).

Table 2-20: Exemplary usability problems of the SEP due to poor labeling

ID	Usability problem description
UP5-1	A link labeled “Ihre Anregungen” (your recommendations) leads to email-form
UP5-2	Difference unclear between two links labeled “Arbeitsmittel” (tools) and “Mitarbeiterservice” (employee service)
UP5-3	Difference unclear between two links labeled “Categories Index” and “Top Categories” (Q1.68)
UP5-4	The label “Marktplatz” (marketplace) is not descriptive enough of the content it links to (Q1.120)
UP5-5	Inconsistent use of labels (“Marktplatz” (marketplace) vs. “Marketplace Home” vs. “Downtown Marketplace” vs. “Downtown Market Place”) (Q7.2)

Another 38 (6.8%) stemmed from inadequate information structure (Table 2-21).

Table 2-21: Exemplary usability problems of the SEP due poor information structure

ID	Usability problem description
UP6-1	“About the portal” should be a sub-entry of the “Help”-section
UP6-2	Path to access the information is too long
UP6-3	Inadequate clustering of information
UP6-4	Hierarchy of information is unclear
UP6-5	Information about “supply chain” is not expected to be found under “learning and knowledge”

Thirty-three deficits were related to suboptimal information and visual design of single pages, amounting to 5.9% (Table 2-22).

Table 2-22: Exemplary usability problems of the SEP due to suboptimal information and visual design

ID	Usability problem description
UP7-1	Colors look obsolete
UP7-2	No visual connection between first- and second level navigation
UP7-3	An icon depicting a screwdriver is not recognized as such
UP7-4	Contrast between text and background too low
UP7-5	Mandatory form fields not sufficiently marked as such

No instance of browser-related problems was recorded (except for SEP-specific, technically disabled browser functionalities, see 2.3.4.3), as this is a generic problem of the web and was out of the study's scope.

Searching the SEP

Although the search functionality of the SEP itself was not within the scope of the usability tests and inspections performed, several issues related to search engine usability did turn up, resulting in 31 deficits (5.6% of all problems). Among them, there were three occurrences (.5%) related to query formulation (Table 2-23).

Table 2-23: Exemplary usability problems of the SEP due to suboptimal search query formulation

ID	Usability problem description
UP8-1	Unclear functionality of the meta-search (Q1.81)
UP8-2	No functionality to search within a given result set (Q1.88)
UP8-3	Scope of search unclear (Q12.7)

Additional 11 problems (2.0%) concerned search engine performance (Table 2-24).

Table 2-24: Exemplary usability problems of the SEP due to suboptimal search engine performance

ID	Usability problem description
UP9-1	Too many hits (Q1.87)
UP9-2	No hits for typical queries (Q7.20)
UP9-3	Search engine too slow (Q1.82)
UP9-4	Same document retrieved 25 times (Q8.20)
UP9-5	Results generally unsatisfying and not helpful (Q1.85)

Another 17 instances (10.0%) were due to results display deficiencies (Table 2-25).

Table 2-25: Exemplary usability problems of the SEP due to suboptimal search results display

ID	Usability problem description
UP10-1	Not clear how search terms are treated (Q1.77)
UP10-2	Feedback "sorry, no results matched!" for zero hits is not helpful (Q7.21)
UP10-3	The search results list does not include information about single hits (Q12.4)
UP10-4	Too many hits on one page, too much scrolling necessary (Q8.12)
UP10-5	Display of results is too complex (Q8.19)

2.3.4.3 Technical Constraints of the SEP

Technical difficulties accounted for 19 usability problems reported, with system response delays being mentioned six times (1.1%). The remaining 13 instances (2.3%) included problems like system crashes, and disabled or impaired browser functions (refresh, history), among others.

2.3.4.4 Conclusion: SEP Deficiencies and Respective Causes

For most of the usability problems found in the evaluation of the SEP, the mere fact that there is a deficit, with no further indication, does not allow to trace them back to a particular root cause listed in 2.3.3. For example, inconsistencies in labeling of navigation elements might be due to distributed responsibilities, poorly managed content or inadequate methods to design and organize information. Thus, while it is possible to treat some of the symptoms (e.g., devising a controlled vocabulary for navigation element labels), the root causes cannot be resolved directly and purposefully. Without addressing the root causes, however, symptoms of web-specific deficiencies may persistently return in other parts of the system.

2.3.5 Consequences of Web-Specific Deficiencies

2.3.5.1 Introduction

From the illustrations given above, it is obvious that there are serious problems posed on the interaction between human user and web-based information system. These problems implicate numerous consequences, both for the end user of the website and ultimately for the organization which owns the website.

2.3.5.2 Psychological Consequences for the End User

A user going through problems in interacting with a website similar to those described above is not only prone to not finding needed information and thus to not being able to complete the given task. Apart from material consequences as described in chapter 2.1.6.2 (e.g., resources spent on finding information, costs of not finding or finding wrong information), the user is also likely to experience a number of associated emotional reactions, from dissatisfaction to frustration to anger, and, as a result, to abandon the website, as an equal or even better alternative is virtually just a click away (Carroll, 1999; Rosenfeld & Morville, 2002). In the literature on emotional and psychological consequences of low hypertext and website usability, two major syndromes related to web deficiencies are emphasized: *lost in hyperspace* and *information input overload* (e.g., Conklin, 1987).

Disorientation: Lost in Hyperspace

Disorientation, in the context of interacting with hypermedia applications such as the web, has been defined by Elm and Woods (1985, p. 927) as a state in which “the user does not have a clear conception of the relationships within the system, does not know his present location in the system relative to the display structure, and finds it difficult to decide where to look next within the system” (Zeiliger, 1998; Doerry, Douglas, Kirkpatrick, & Westerfield, 1997). This feeling of *lost in hyperspace*, as it is often referred to, is likely to increase with:

- the amount of information available
 - the occurrence of unexpected events which demand recovery strategies⁹⁹
 - the diversification of access modes (combination of searching and browsing modes)
- (Thüring, Hannemann, & Haake, 1995; Doerry et al., 1997; Zeiliger, 1998; Carroll, 1999)

All three variables have been shown to be relevant to the WWW¹⁰⁰. However, Nielsen, (1997b; see also 2.3.2.2), among others (e.g., Mat-Hassan & Levene, 2001; Morville, 2001), argues that the combination of browsing and searching mechanisms rather improves user’s performance by allowing for powerful and flexible information finding. Thus, although the diversification of access modes can potentially overwhelm novice users with a huge number of choices and functions in an integrated search-and-browse interface, it seems that this disorientation is less a result of the integration itself than of insufficient design of integrated search-and browse interfaces. The effective integration of search and browse mechanisms, e.g. by using faceted navigation approaches, is therefore a major objective of IA efforts (Nielsen, 1997b; Morville, 2001; Rosenfeld & Morville, 2002; Veen, 2002; see also 2.1.6.2).

In order to quantify the degree to which users become lost in a given system, Elm and Woods (1985; also Smith, 1996) contend that this *lostness* should be viewed rather in terms of degradation of task performance than the user’s subjective feelings. In this line, Smith (1996) derived a measure for lostness (L) that, for a given information-finding task, relates number of different nodes visited whilst searching in a hypertext system (N) to the total number of nodes visited (S), and the number of nodes actually required to complete the task (R):

$$L = \sqrt{\left(\frac{N}{S} - 1\right)^2 + \left(\frac{R}{N} - 1\right)^2}$$

⁹⁹ For example, missing documents, modified content, and variable response time.

¹⁰⁰ See 2.3.2.1 for the increase in amount of information and the dynamic character of the web, 2.3.2.2 on the development and integration of browse and search mechanisms, and 2.3.2.3 on technical constraints including response time.

Thus, as the score progresses from $L = 0$ to $L = 1$, the level of lostness increases from minimum to maximum lostness.

Information Input Overload

Information input overload has been described by Hall (1998, p. 37) as “a superabundance of information, some of which may be irrelevant or of dubious quality, that arrives too quickly, [and which] can be damaging to employees and their business”. Symptoms for an overload of information input are, among others, forgetfulness, headaches, bad temper, loss of concentration, sleep disturbance, anxiety, computer “rage” (literally hitting the PC), and increased illness (Welsh, 1997). Komischke (2003), reviewing relevant literature, lists a number of factors that contribute to information input overload:

- Limited human information processing capacities
- Inadequate techniques to deal with information
- Sheer amount of existing and new information
- Limited processing power of computer hardware and software

With respect to the web, technological progress might possibly ease the latter one, whereas the former two are inherent characteristics of humans, and thus cannot be easily alleviated by advances in technology or design. At the most, users’ techniques for dealing with information can be improved in the long term by educational efforts, e.g. by teaching skills in search engine usage in school, as proposed by Nielsen (1997b; see also Morrogh, 2003; Nielsen, 2001). The third factor, amount of information, is likely to become even more pressing in the future (see 2.3.2.1).

Typical strategies to cope with information input overload include:

- Omission: Temporary and arbitrary non-processing of information
- Error: Incorrect processing
- Queuing: Delaying response during high load in hope of catching up later
- Filtering: Neglecting certain categories of information while processing others
- Approximation: Being less precise for the sake of speed
- Multiple channels: Distributing processing if possible
- Escape: Escape from the task

(Miller, J. G., 1960; 1962; 1964; Komischke, 2003)

On the web, users try to counteract information input overload for example by developing a personal information space using bookmarks which helps in pre-selecting high-quality information (equaling *omission* and *filtering* of information; Abrams & Baecker, 1997; see

2.3.2.2). However, as outlined in 2.3.2.2, users nevertheless become regularly frustrated (e.g., 70% of all users when using a web search engine; Charny, 2000), frequently give up (50% of all users in case the first search query does not work; Nielsen, 2001), and rather ask a colleague face-to-face or on the phone for the information needed (resembling *escape* and *multiple channels*; Farrell, 2001). This pervasiveness of lostness on the web, together with the largely irresolvable nature of most of its contributing factors, emphasizes the need for improving the organization of and end user access to information within web-based systems.

2.3.5.3 Economic Consequences for the Organization

In a business area such as internet or intranet websites, where success is largely dependent on the user's ability and willingness to actually take actions on the website (see Chapters 1 and 2.3.1), deficiencies such as described in 2.3.2, together with their respective psychological consequences on the user's side (see 2.3.5.2 above), quickly turn into economic losses for the sponsoring organization. As explained in the following, estimating these losses is a first step in calculating the return on respective IA investments (ROI)¹⁰¹.

Caveats in Calculating Return on IA Investments

As was pointed out in 2.1.6.3, efforts to develop a high-quality IA system can pay off in numerous ways, including increased employee satisfaction and productivity, higher competitive advantage, increased sales and improved customer relationships, but also reduction of construction, training, maintenance, and service costs. However, in practice, it is challenging to prove this assertion, due to several reasons:

1. High effort necessary for and low benefit of validly proving benefits
2. An IA system is more than the sum of its parts
3. An IA system is an abstract model
4. Many costs and benefits of an IA system cannot be quantified
5. Figures for IA benefits are, ultimately, hopeful predictions

(Toub, 2000; Feldman & Sherman, 2001; Wright, 2001; Rosenfeld & Morville, 2002)

(1) *High effort necessary for and low benefit of validly proving benefits*: To really establish a causal link between modifications in a website's IA system and site metrics, a large-scale and tightly-controlled study would be necessary that for example compares, in terms of user performance, two alternatives of the same website which only differ in the modified IA compo-

¹⁰¹ ROI: Return On Investment. ROI is a basic metric for estimating the value of investments; it can be defined as: (average benefit over three years) / (initial costs) (NucleusResearch Inc., 2002).

nents. As in addition, the validity of such results is confined to the website under observation and not easily transferable to other websites, the “cost-benefit ratio” of this approach itself would be very low (Rosenfeld & Morville, 2002; Toub, 2000).

(2) *An IA system is more than the sum of its parts*: In general, it is possible to measure the impact of single IA system modifications, e.g., changing a navigation hierarchy from deep and narrow to a broad and shallow structure, or modifying the labels for a navigation system. However, the sheer number of components relevant to a complete IA system (see 2.1.3) and the possible interaction effects that come with it, make it hardly possible to either validly reduce the number of variables in question or assess the overall quality of the IA system (Rosenfeld & Morville, 2002; Toub, 2000)

(3) *An IA system is an abstract model*: While it is generally possible to assess qualities of a website (e.g., if it meets user and business goals or if it allows for completion of a certain task), this is not the same as evaluating the site’s IA system, which merely is the blueprint that lays the groundwork for the design of the site (Toub, 2000).

(4) *Many costs and benefits of an IA system cannot be quantified*: As pointed out in 2.1.6.2, a high-quality IA system may benefit users of the respective information system in many ways; however, when turning to user needs and requirements not associated with a definite goal, such as being entertained or explorative information gathering (“seeing what’s there”), it becomes more difficult to measure success.¹⁰² In addition, some costs of a low-quality IA system such as poor decisions, or impaired communication and interaction between employees, are hardly quantifiable. Thus, benefits and costs of IA system quality cannot always be measured in monetary terms (Feldman & Sherman, 2001; Rosenfeld & Morville, 2002; Toub, 2000; Wright, 2001). In this respect, the discipline of IA is different from other areas of information system development, like for example web hardware technology, where benefits can readily be measured in terms of (objective) improved server load balance and performance (Rosenfeld & Morville, 2002; Toub, 2000).

(5) *Figures for IA benefits are, ultimately, hopeful predictions*: Any attempt to estimate the actual benefit of IA efforts has to make assumptions, estimations, and simplifications with regard to many variables.¹⁰³ In addition, the actual realization of the desired benefits for a real website is dependent on many additional variables, including other (e.g., technical) modifica-

¹⁰² For more details, see 2.2.6.3 on the limited use of usability measures in IA system evaluation.

¹⁰³ Examples for these variables include time saved in searching for information; how much time people spend searching on the average; how many people will be affected by the modifications; how each of them will react to the changes; if the time saved is indeed spent productively.

tions to the website, competitor's activities, or such remote aspects as the growing number of web users which might increase or decrease the success of the website. This restricted validity, however, is true for most ROI calculations (Rosenfeld & Morville, 2002; Toub, 2000; Rosson & Carroll, 2002).

Thus, calculating the benefits of IA investments is constrained by inherent threats and limitations. However, this does not mean that such calculations are useless. Rather, while using the figures as a basis for planning and selling IA activities, it is important to be aware of their inherent limitations, and to constantly evaluate and improve existing IA ROI models.

Benefits of Information Architecture Investments

A first step in calculating the benefits of IA investments is to estimate the financial loss due to deficient IA systems. For corporate intranets, Feldman and Sherman (2001) contend that, on average, an organization employing 1000 knowledge workers wastes:

- \$48,000 per week due to employees' inability to locate and retrieve information¹⁰⁴
- \$5 million per year because employees duplicate already existing information¹⁰⁵
- more than US\$15 million per year due to opportunities not seized¹⁰⁶

The authors argue that other costs related to problems with information finding, for example costs stemming from poor decisions (see also 2.1.6.2), dissatisfaction and low motivation of employees, lost sales, and lost working time due to information seekers asking and interrupting colleagues instead of the system (see also 2.1.6.3), are hard to quantify, but nevertheless, additionally contribute to an enterprise's cost burden.

Even if such figures partially rest on hardly verifiable assumptions (e.g., that each knowledge worker spends 2.5 hours a week searching; see Footnotes 104, 105, and 106) and obviously discount the effect of other variables (e.g., if time saved through better information finding would be really spent productively by employees; see caveat #5 above), they nevertheless

¹⁰⁴ This figure rests on the following assumptions: (1) a knowledge worker's salary equals \$80,000 plus benefits per year, (2) each knowledge worker spends 2.5 hours a week searching on average, and (3) 50% of information available within the enterprise are not centrally indexed and thus not searchable (Feldman & Sherman, 2001). Calculation of cost: $[(\$80,000 / 52 \text{ weeks}) / 40 \text{ hours/week}] \times 2.5 \text{ hours/week searching} \times 1,000 \text{ knowledge workers} \times 50\% \text{ unindexed information} = \$48,000 \text{ per week, or } \$2.5 \text{ million per year}$

¹⁰⁵ This figure uses a metric called "knowledge deficit", which "captures the costs and inefficiencies that result primarily from intellectual rework, substandard performance, and inability to find knowledge resources" (Feldman & Sherman, 2001, p. 7). Estimates for knowledge deficit within organizations range from \$5,000 per worker per year in 1999 to \$5,850 in 2003 (Feldman & Sherman, 2001). Calculation of cost: $1,000 \text{ knowledge workers} \times \$5,000 \text{ per year} = \5 million

¹⁰⁶ This figure rests on the assumptions of (1) revenue per employee: \$500,000 per year, or \$240 per hour, (2) 50% failed searches, and (3) 2.5 hours searching. Calculation of opportunity cost: $1,000 \text{ employees} \times 50\% \text{ failed searches} \times \$240/\text{hour} \times 2.5 \text{ hours searching per week} = \$15 \text{ million per year}$

give an indication of the magnitude of costs associated with poor information finding in web-based information systems (Feldman & Sherman, 2001; Rosenfeld & Morville, 2002).

The next step in cost-justifying IA efforts, however, is to estimate to what extent a given effort is believed to remedy those problems. Approximations can be derived from (1) experience from past projects, (2) data published in the literature, (3) benchmark values, and (4) expert judgment (Karat, 1997). With regard to IA, there are rarely actual figures reported in the literature yet; however, according to Rosenfeld and Morville (2002), it is possible to take over calculations from similar or overlapping areas of UCD practice (e.g., Usability Engineering). Such calculations are provided by analyst firms like Forrester Research or IDC (Souza, Manning, Sonderegger, Roshan, & Dorsey, 2001; Feldman & Sherman, 2001), but also from usability experts (e.g., Bias & Mayhew, 1994; Karat, 1997; Marcus, 2002a; Nielsen & Giltz, 2003). In a retrospective cost-benefit analysis by Karat (1997), a project is described for developing a security application used by 22,876 users. The benefits of usability activities were estimated in terms of timesaving per performance of a given task, which averaged 4.67 minutes, resulting in a monetary benefit of US\$ 41,700 (see Table 2-26).

Costs of Information Architecture Investments

In contrast to the sometimes intangible benefits of such UCD efforts, the respective costs are much more concrete, bearing on personnel time and equipment necessary to conduct the respective activities (Karat, 1997; Mayhew, 1999; Rosson & Carroll, 2002). In the exemplary analysis by Karat, costs due to usability activities amount to US\$20,700 (see Table 2-26).

Cost-Benefit Analysis and Return on Investment

In sum, Karat's retrospective analysis shows a cost-benefit ratio of 1:2, i.e., for every dollar spent, there is a return of \$2 in the first year of application development. In terms of return on investment, this would make a ROI of 200% for the first year. ROI measures for UCD activities vary widely (Feldman & Sherman, 2001).¹⁰⁷ This variability partly stems from whether a project aims at an incremental improvement of already existing processes and systems (lower) or at introducing entirely new systems and processes, replacing previously manual processes (higher ROI figures; e.g., Karat's, 1997, 10,000% ROI; Feldman & Sherman, 2001).

¹⁰⁷ Figures for ROI of UCD activities, as described in the literature, include:

- 38% (Feldman & Sherman, 2001; improved access to information not further specified)
- 178% (Sun improving its intranet IA system; Rosenfeld & Morville, 2002)
- 333% (Bay Networks improving information access within its intranet; Fabris, 1999; Nielsen, 1999a)
- 600% (Feldman & Sherman, 2001; improved access to information not further specified)
- 10000% (Karat, 1997, in another example than the one given above)

Table 2-26: Exemplary cost-benefit analysis of user-centered design investments

Estimated Benefits	Estimated Costs	Cost-Benefit Ratio
Reduction in task time from initial to final version: 4.67 minutes End user population: 22,876	Usability resource = \$18,800 Participant travel = \$700 Test-related development work = \$1,200	
Estimated total benefits: 22,876 users x 4.67 minutes x productivity ratio x personnel costs = \$41,700	Total cost for a year = \$20,700	Cost-Benefit Ratio: $\$20,700 / \$41,700 = 1/2$ Return on Investment (ROI): $(\$41,700 / \$20,700) \times 100 = 200\%$

Note. Source: Karat 1997, p. 774; see Rosson & Carroll, 2002, for a similar display of Karat's results.

3 Research Approach

3.1 Outline of the Chapter

In the following, the overall research approach of the thesis is derived from the delineations in the previous chapters. While Chapter 3.2 describes the overall motivation for the thesis and its scope (i.e., what is to be achieved *with* the thesis), Chapter 3.3 focuses on the immediate goals and intended deliverables of the thesis per se (i.e., what is to be achieved *in* the thesis), as well as it demonstrates the need for this research. Finally, Chapter 3.4 describes the overall approach laid out to achieve the objectives and realize the overall purpose.

3.2 Purpose and Scope of the Thesis

From the description of web-specific deficiencies and their consequences in the previous Chapter 2.3, it is obvious that there is a need both for the sake of user satisfaction as well as business performance to alleviate the problems users encounter when interacting with the web. Hence, the fundamental, leading question that initiated the work on this thesis was:

Leading question for the thesis:

How can you ensure that users are able to find and use what they need to achieve their goals?

However, improving user goal achievement is usually not a means to itself. Therefore, by advancing end user performance, this thesis also aims at improving business goal achievement and leveraging the benefits of IA practice and User-Centered Design for the sponsoring business as outlined in 2.1.6.3 and 2.2.6.1. In sum, the purpose of the thesis is summarized as:

Purpose of the thesis:

Improve user and business goal achievement in web-based information systems.

Deconstructing the leading question, constituting elements of its solution and thus of the thesis' scope can be derived:

How can you ensure: this points to the need for describing the *means* to improve user goal achievement. For a particular website, the thesis' purpose might be realized by describing a specific website or IA system design; however, a generic solution should include a description of how to realize the purpose for any web-based information system.

...that users are able to find: as explained in 2.3.2.2, the vast majority of tasks users perform in an information-heavy environment as the web, involves finding specific information. Thus, improving the access to information is a key element of the intended solution.

...and use: however, finding information is usually not a means to itself, but always tied closely to an end. Therefore, enabling users to generate knowledge from, and act on the information (using the site's functionality), represents another vital aspect of the solution.

...what they need: in order to support users in achieving their goals, any design solution must take into account their individual needs regarding characteristics of a website's information and functionality. Thus, user needs are another major determinant for the intended solution.

...to achieve their goals: end user goal achievement in web-based information systems can be operationalized by applying various usability measures. Usability, in general, does not account equally well for evaluating all aspects of an IA system (see 2.2.6.3). However, in this thesis, the focus is mostly on directed information seeking, which lends itself very well to be described in terms of usability metrics, as task end states can usually be easily defined. Thus, usability is used as the key metric for evaluating users' goal achievement and hence for assessing to what extent the objectives of the thesis are achieved.

3.3 Objective of the Thesis

Put into more concrete terms, maximizing the chance for users to achieve their goals, implies to minimize the occurrence or the impact of problems users encounter when interacting with such information systems. However, this can only be achieved by means of - and therefore the immediate *objective* of the thesis must be - an improved *Information Architecture Process Model*, due to the following reasons:

Objective of the thesis:

Developing a Comprehensive Information Architecture Process Model.

Information Architecture:

Because of its central and unique role in information system development, with widespread overlaps and strong dependencies to all major disciplines involved (see 2.1 and 2.2), the discipline of IA naturally is the one affected by and concerned with all of the five root causes. Thus, *organization needs trumping user and content needs*, *weak technology*, and *inadequate methodologies for designing and organizing information* are reflecting core IA tasks of aligning technology constraints and business goals with user needs, and subsequently defining the organization of and the access to information (see 2.1.4). Other disciplines, such as Content Management and Database Design, while also in need of identifying user requirements, usually do not have direct access to real users, as it is the case in IA processes (see 2.2.7.1, 2.2.5.1, and 2.1.4).

Due to the close relationship with Content Management (see 2.2.7.2), IA also contributes significantly to alleviating *poorly managed content*, i.e., improving poor Content Management processes, especially when it comes to identifying users' content needs, and defining content requirements such as metadata schemata and controlled vocabularies.

While *inadequate differentiation of responsibilities* actually is a project management issue, information architects often adopt the role of an orchestra conductor, guiding the overall team effort and serving as the interpreter between single team members and responsibilities, and hence, are also well-equipped for addressing this issue (see 2.1.2.4).

Information Architecture Process:

Although the web-specific deficiencies described in 2.3.2 are symptomatic for many of today's websites, every website is unique in its focus, business goals, content, functionality,

target user group, user needs, and resulting usability problems. At the same time, any one of them might change over time with regard to these characteristics. Thus, a generic and permanent resolution of the deficiencies has to account for both differences within and between individual websites. Accordingly, not any fixed IA system design would really solve a problem, but rather suspend it temporarily, and this only for the website it was designed for.

In addition, really solving the problems implies not only curing the symptoms, but also addressing the root causes for these symptoms as described in 2.3.3. These five causes, however, rather than describing aspects of deficient design solutions, operate at the level of the underlying design/development and maintenance processes:

Cause #1: Organization needs trumping user and content needs: a given design solution might show the primacy of either business or user needs, e.g. in the way content is organized. However, these strategic decisions are made within, and thus have to be improved on at the level of, the underlying development process. The insufficient description of how to balance and resolve conflicts between user and business needs in available process descriptions (see 2.1.4.1) hinders existing IA process models from fostering deliberate decisions, and from delivering IA systems that successfully support both user and business goal achievement.

Cause #2: Inadequate differentiation of responsibilities: responsibilities are held within processes. Accordingly, to treat this root cause, changes have to be made to the underlying processes. Available IA process descriptions frequently remain high-level when defining roles, responsibilities, and dependencies between information system elements, and thus do not effectively support interdisciplinary collaboration (see 2.1.4.3).

Cause #3: Weak technology: whether the technology satisfies user needs turns out in real-life use of the information system. However, decisions regarding hardware and software technology and their implementation happen during the development process. The lack of alignment of Data Modeling and IA in available IA process descriptions (see 2.1.4.2), however, hinders existing IA process models from providing critical input regarding end user needs to the Database Design process, hence from fostering deliberate decisions on which technology to implement, from ensuring technical feasibility and efficient technical IA system implementation, and from minimizing technical constraints-related web deficiencies.

Cause #4: Poorly managed content: the management of content is a process in itself (see 2.2.7.1). The insufficient alignment of IA and CM processes, as well as the lack of attention to content provider needs and capabilities in current IA process descriptions (see 2.1.4.3), prevents existing IA process models from ensuring content-related feasibility and efficient con-

tent-related implementation, high-quality (in end user terms) content across content providers and across time, from providing crucial input regarding end user needs to the CMS development process, and thus from supporting adequate planning of the CM process.

Cause #5: Inadequate methodologies for designing and organizing information: the collection of methods applied in designing and organizing information is a vital element of the overall website development process. Although technically available today, many IA and other UCD methods are not embraced and their value is not fully leveraged, in part due to inaccessible descriptions of their selection, application, and integration within the overall website development process in existing IA process models. This is especially true for integrating bottom-up IA methods into traditional top-down IA processes (see 2.1.4.1 and 2.1.4.2)

Information Architecture Process Model:

The vast diversity of websites today, together with the unique characteristics of any website development project in terms of project focus, objectives, monetary and temporal constraints, availability of methods, staffing, and expertise accessible, requires the process applied in each project to be adjusted to its individual constraints. Available IA process descriptions, as shown in 2.1.4.1, frequently deliver ineffective and inefficient process instances, due to their inappropriateness for and insufficient scalability to given project constraints. To be effective and efficient, therefore, a description of an IA process has to account for this diversity and accommodate individual project constraints. Hence, this thesis aims at a generic and scalable process description, a process *model*.

Wrapping up, the purpose of this thesis is to improve both business and end user goal achievement in web-based information systems. To achieve both in a generic and permanent manner, the root causes for web-specific deficiencies for end users, such as described in 2.3.2, have to be resolved at the level of the underlying IA process. Current IA process descriptions fail at addressing these root causes. The objective of this thesis is thus to develop an *Information Architecture Process Model* describing the overall design and development of a website's IA system. To address the root causes for web-specific deficiencies sufficiently, vital characteristics of the to-be developed process model have to be:

Vital characteristics of the to-be developed Information Architecture Process Model:

- delivering IA systems which support both user and business goal achievement
- enabling efficient IA process instances
- generic and scalable description of the process

Additional characteristics:

- adequate allocation of responsibilities, support of interdisciplinary collaboration
- accounting for business strategy requirements and aligning Corporate Branding and IA process flow to translate business goals into the website's IA system and align business with user needs
- integrating Data Modeling, and aligning Database Design and IA process flow to ensure technical feasibility and efficient technical implementation of the IA system, to minimize technical constraints-related web deficiencies, and to support the Database Design process with critical input regarding end user needs
- explicitly accounting for content provider requirements and aligning Content Management and IA process flow to ensure content-related feasibility of the IA system and efficient content-related implementation, high-quality content (in terms of end user requirements) across content providers and across time, and to support the CM process with crucial input regarding end user needs
- accessibly describing the process and the use of single methods within this process

3.4 Outline of the Research Approach

To arrive at the proposed process model, in this thesis a result-driven approach is adopted, i.e., characteristics of the process model are derived from its intended outcomes. Thus, the research approach rests on an initial analysis of IA systems, followed by an analysis of IA processes. From the results of these analyses, target criteria for the to-be developed process model can be derived, and subsequently, the process model is synthesized based on the results of the analyses. Finally, the process model is evaluated in terms of the degree to which target criteria are met. In more detail, the research approach includes the following sub-steps:

Analysis:

- Step 1: System analysis (Chapter 4.1): identifying the components of IA systems, the dependencies between them, and individual deficiencies of components
- Step 2: Process analysis (Chapter 4.2): identifying the actual state of IA processes and their respective deficiencies

Target Criteria Definition:

- Step 3: deriving target criteria for the evaluation of the intended process model from previously identified deficiencies of IA systems and processes (Chapter 4.3)

Synthesis:

- Step 4: Process setup (Chapter 4.4): assembling the process model by defining single process phases, process steps, and the overall process flow of input and output
- Step 5: Methods catalog (Chapter 4.5): collecting methods applicable for single process steps, including respective cost and benefits

Evaluation:

- Step 6: Expert evaluation focus groups (Chapter 4.6): evaluating the process model by performing focus groups with domain experts
- Step 7: Validation project (Chapter 4.7): deducing an IA process instance from the model and carrying out an IA project according to this process instance; evaluating the process instance and thereby the process model

Redesign:

- Step 8: Redesign of IA process and system model (Chapter 4.8)
- Final results (Chapter 5)

The sequence of steps taken in developing and evaluating the process model can be visualized as a movement in a three-dimensional space, where the horizontal axis shows the aspect of the concept IA dealt with (system vs. process), the vertical axis portrays the level of maturity in terms of stages of development (from actual state to deficiencies to optimized state), and the z-axis depicts the level of abstraction (concrete instance vs. general model; see Figure 3-1).

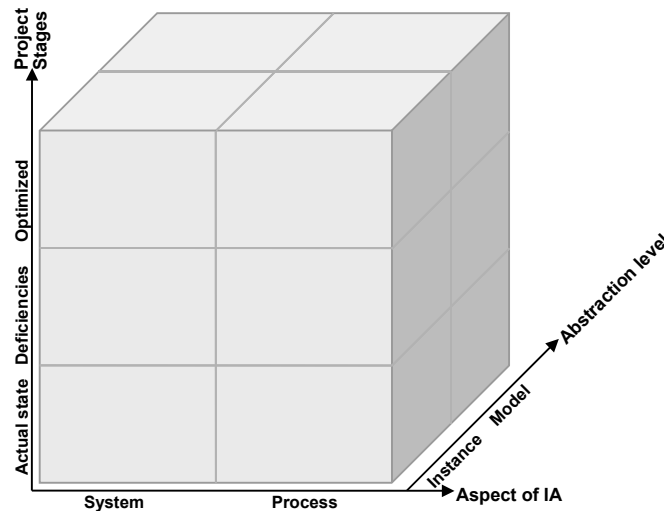


Figure 3-1: The Information Architecture Cube as a visualization of the research approach taken in this thesis

Thus, the overall objective of the thesis is to arrive at the upper right rear corner of the cube, an optimized (y-axis) process (x-axis) model (z-axis), while the starting point of the analysis naturally can only be instances (z-axis) of IA systems and processes (x-axis) in their actual state (y-axis; see Figure 3-2). In the following, single steps of the research approach taken are each introduced using this three-dimensional metaphor.

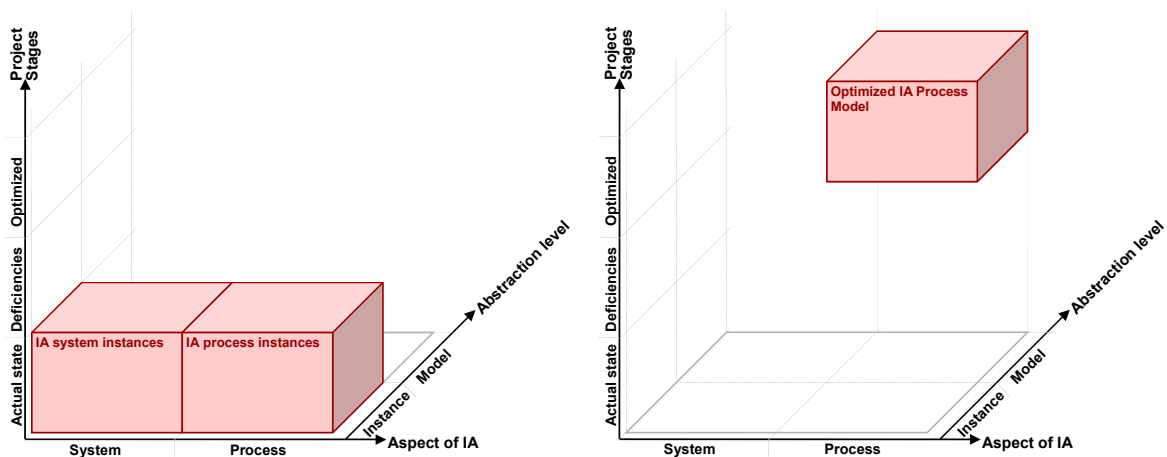


Figure 3-2: Starting point (left) and overall objective (right) of this thesis

4 Realization

4.1 Step 1: System Analysis

4.1.1 Introduction and Overall Objectives

As outlined in 2.1.3, no consensus has yet been achieved on what components make up an IA system. Thus, in order to be able to focus the intended IA process model, this initial step aimed at analyzing IA system instances with regard to:

- the *components* of IA systems (step 1.1)
- the *deficiencies* of individual IA system components (step 1.2)
- the *dependencies* between individual IA system components (internal dependencies), and between IA system components and other components of the overall information system (external dependencies) (step 1.4)

From the deficiencies identified in step 1.2, optimum values for IA system components could be derived in step 1.3.

4.1.2 Step 1.1: IA System Components

4.1.2.1 Outline and Objectives

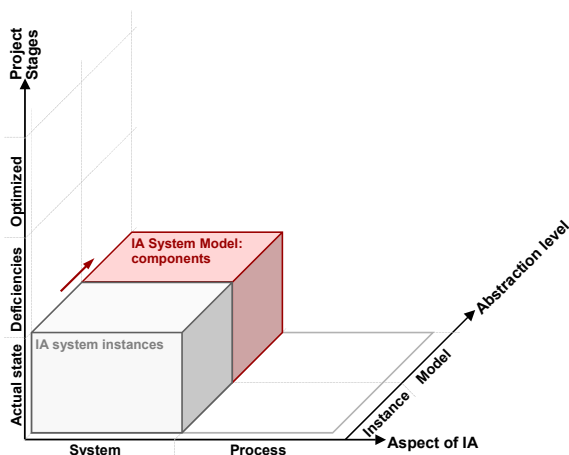


Figure 4-1: Visualization of step 1.1

Outline: From instances of actual state IA systems described in the literature, a model of IA system components is induced (the IA System Model V0.1).
Objectives: generalizing from available IA system descriptions a highest common denominator of what components make up an IA system, and hence, what an IA process is supposed to be able to deliver, in order to focus the to-be developed IA process model.

4.1.2.2 Methods and Materials

A literature review was performed on available IA system descriptions. The material for the analysis comprised 24 source documents, including IA books, IA articles published in paper and electronic magazines, contributions to IA discussion lists, profiles of information architects and IA companies, IA job postings, and Siemens-internal IA and UCD documentation.¹⁰⁸

The material was analyzed using the approach of inductive category development (Mayring, 2000; 2003; see 2.2.6.1). This method was chosen because of its:

- adequacy for the type of material (textual documents)
- focus on qualitative analysis of semantic content
- focus on developing a system of categories
- systematic, rule-based approach, supporting objectivity, transparency, and traceability

The actual analysis was performed using a software program called ATLAS.ti (Muhr, 1997). This software package (see Figure 4-2), among a vast array of other functions, allows for:

- all material (“primary documents”) to be assembled in one workspace
- easy assignment of a category (“code”) to a text passage (“coding”)¹⁰⁹
- a visualization of these code assignments within the workspace
- a network representation of code relationships, also across primary documents

However, with the current state of technology, the actual act of coding a text passage, i.e., identifying a relevant text passage, choosing an adequate category, and assigning this category to the text passage, remains a human task. The basic process of inductive category development as outlined in Figure 2-19 on Page 67 was slightly modified to accommodate several constraints; thus, the procedure consisted of:

1. Defining the research question
2. Specifying criteria for defining categories
3. Inductively developing categories (i.e., IA system components) from the text material
4. Revising the final system of IA components

¹⁰⁸ Source documents included (in alphabetical order): Bollaert, 2002; Boogards, 2001; Buchholz, 2001; Danzico, 2003; Davis, Rebecca, 2001; Siemens AG, 2002; Degen, Pedell, & Schoen, 2003; Doss, 2002; Experient LLC, 2003; Fullerton, 2002; Gent, 2001; Hill, 2001; IAwiki, 2003, 2003a, 2003b; Morville, 2001; Poel, 2001; Rhodes, 2000; Rosenfeld, 2001a; 2001c; Rosenfeld & Morville, 2002; StarDevs, 2002; Vodvarka, 2000; Wodke, 2001; Wright, 2001

¹⁰⁹ Coding could be performed through (1) drag-and-drop of already defined codes to marked text, or (2) right mouse-click of marked text and defining a new code, using an arbitrary code label.

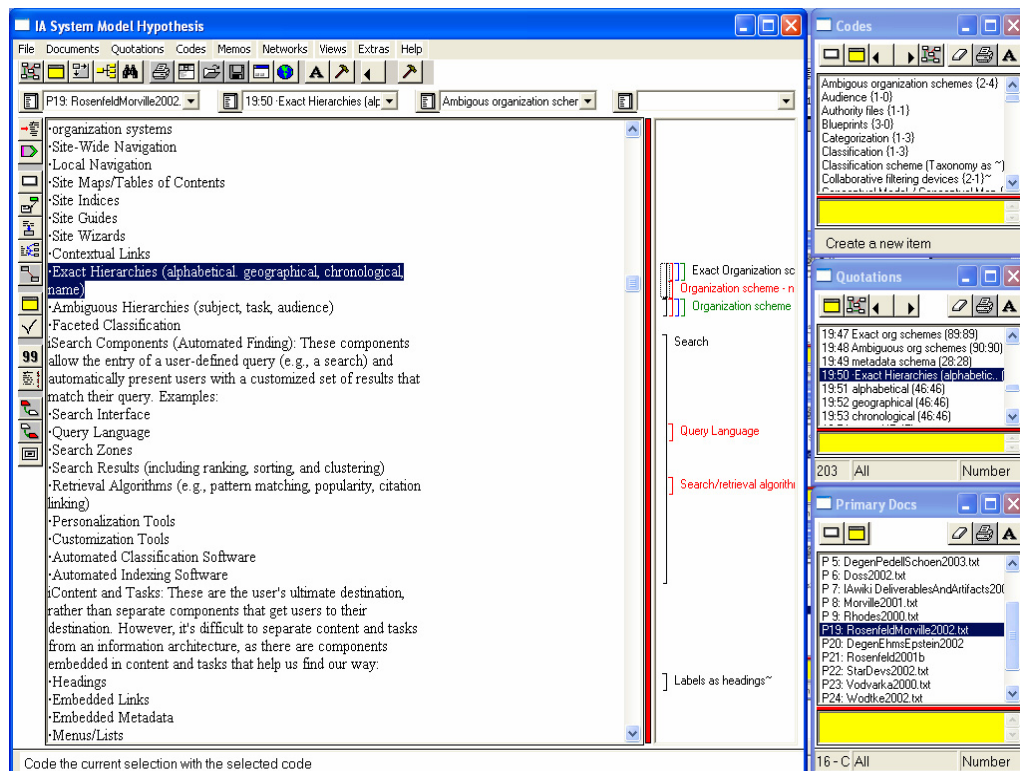


Figure 4-2: The workspace of ATLAS.ti (Muhr, 1997)

Deriving from the objective for this step, the basic research question was, “What components does an IA system have?” *Components of an IA system*, in this context, were initially defined broadly as “the deliverables of IA efforts”. However, this definition did not discriminate between deliverables which turn into elements of an overall information system, and other IA process deliverables (e.g., user scenarios or content inventories), although the focus here is on the former. Therefore, to exclude deliverables used only within the IA process or to communicate the results of the IA process, IA components were re-defined as “the parts of an information system an information architect can deliver”. This definition consciously depended on the underlying definition of the role of the information architect, in order to allow for a broad analysis of the practice in industry today. After this specification, eight out of the 24 primary documents were excluded from the analysis because of their focus on process deliverables. No a-priori restriction of level of abstraction was imposed, as this was implicitly prescribed by the focus on IA system components. The resulting 16 primary documents were then sequentially analyzed. Because of the limited corpus size, no intermediate category refinement was performed. The proof of inter-rater reliability of the results was skipped as the categories generated in this step were repeatedly validated by deductive application in step 1.2 and during expert interviews performed in step 1.4.

4.1.2.3 Results: IA System Model V0.1: Components

The literature review resulted in an IA System Model V0.1 comprised of five main components: (1) Content, (2) Organization Systems, (3) Labeling Systems, (4) Navigation Systems, and (5) Search Systems (see Figure 4-3, from left to right).

1 Content	2 Organization systems	3 Labeling systems	4 Navigation systems	5 Search systems
Content scope Content quality Content language (wording)	Classification <ul style="list-style-type: none"> • Metadata schema, • Controlled Vocabularies • Dynamic content delivery processes Categorization <ul style="list-style-type: none"> • Site Map • Taxonomies 	Content/ Organization labeling systems Navigation/ Search labeling systems	<ul style="list-style-type: none"> • Site-wide Navigation • Local Navigation • Site Maps/Tables of Contents • Indices, Guides, Wizards • Contextual Links • Exact Hierarchies • Ambiguous Hierarchies • Faceted Classification 	<ul style="list-style-type: none"> • Search Interface • Query Language • Search Zones • Search Results (including ranking, sorting, and clustering) • Retrieval Algorithms <ul style="list-style-type: none"> • Personalization Tools • Customization Tools

Figure 4-3: IA System Model, V0.1: IA system components

This classification of IA components is in large parts reflective of Rosenfeld and Morville's delineations in their founding book on IA (1998, 2002; see 2.1.3.1): Components (3) through (5) are virtually identical with their descriptions, while Organization Systems (2) here are split into (2.1) "Classification" sub-components (metadata and controlled vocabularies) and (2.2) "Categorization" sub-components, comprised of Rosenfeld and Morville's organization schemes and organization structures. Component (1), "Content", is introduced to account for the characteristics of information and functionality relevant to IA efforts, similar to Vodvarka's description of IA components (1998; see 2.1.3.1). It is comprised of three subcomponents, pertaining to the scope, semantic and textual qualities of the information, and the language used (wording characteristics) for communicating it.

4.1.3 Step 1.2: Deficiencies of IA System Components

4.1.3.1 Outline and Objectives

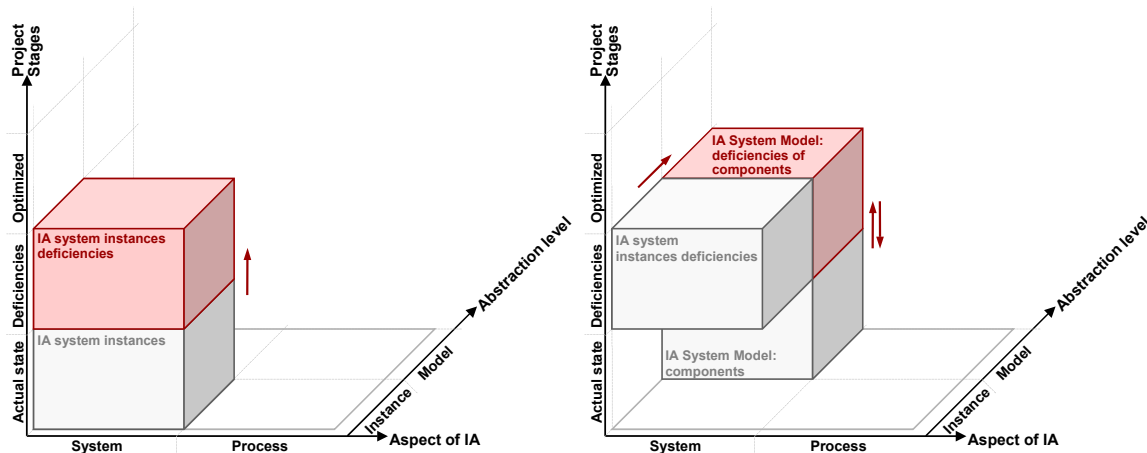


Figure 4-4: Visualization of step 1.2

Outline: Analyzing two Siemens intranet websites, deficiencies of IA system instances are identified, which pertain to either end users or content providers (left diagram). Tracing back these system instance deficiencies to components of the IA System Model V0.1, a model of deficient IA systems (the IA System Model V0.2) is induced, thereby validating and revising the components of V0.1 (right diagram).

Objectives: as any collection of IA system instances cannot be expected to include all potential system deficiencies, the goal in this step was not to exhaustively identify all possible IA system deficiencies; rather, the objectives were:

- Identifying a maximum of relevant IA system deficiencies, to be addressed in the IA process
- Confirming the impact of IA system quality on end user goal achievement
- Confirming the impact of IA system quality on content provider goal achievement
- Validating and revising the IA System Model V0.1

4.1.3.2 Methods and Materials

In order to identify deficiencies of IA system instances pertaining to either end users or content providers, a threefold approach was followed:

For deficiencies *relevant to end users*, (1) usability evaluation results for the Siemens Employee Portal were re-analyzed, and (2) literature on deficiencies of IA system components not covered by the usability evaluation results was reviewed. For deficiencies *relevant to content providers*, (3) interviews with content authors, editors, and content managers of the Siemens Employee Portal and the Siemens ShareNet, a collaborative knowledge management tool integrated in the Siemens intranet environment, were conducted (N=25).

Data was analyzed identically in all three approaches; therefore, in the following, only data collection methods and respective materials are described separately for each of the three approaches, followed by the generic data analysis procedure.

Usability Evaluations of the Siemens Employee Portal

The data from the usability evaluations of the SEP, including more than 550 individual instances of usability problems, were already introduced in detail in Chapter 2.3.4.

Literature Review

Since the usability evaluation of the SEP did not address all sub-components of the IA System Model V0.1, the analysis of deficiencies relevant to end users was completed by reviewing literature on three IA system sub-components: site indexes, sitemaps, and guides/wizards.¹¹⁰ Material for the review comprised 22 source documents, including articles published in paper and electronic magazines, usability reports from usability consultancies and government agencies, and design manuals from software vending companies. As in step 1.1, many of these documents were retrieved online.¹¹¹

Interviews with Content Providers of Siemens Employee Portal and ShareNet

The interviews conducted with content providers for Siemens intranet websites were split into two iterations: interviews with (1) 12 professional content providers of the Siemens Employee Portal, and (2) 13 users of the Siemens ShareNet who previously had provided content. For both iterations, the overall interviewing method could be classified as *semi-structured, focused field interview* (see 2.2.6.1). This implied the use of an interview script with pre-defined questions (see Appendix B-1.1), a focus on the experiences interviewees gained while performing their tasks of providing and managing content for the respective system, and conducting interviews at the respondent's workplace. Interviews were carried out by the author and lasted approximately 1 hour. The basic procedure in both iterations included:

- Welcome
- Introduction to the interview's focus, goals, and procedure
- Identification of typical tasks, responsibilities, and experiences of the interviewee
- Main section: identification of potential problems stemming from IA system components using three (iteration 1) or one major task scenario (iteration 2)
- Wrap-up and debriefing

¹¹⁰ Other sub-components, like personalization and customization mentioned in the IA System Model V0.1 were subsequently deleted from the model, and thus no further analysis of respective deficiencies is reported.

¹¹¹ Source documents included, for the analysis of deficiencies related to (in alphabetical order):

- indexes: Lathrop, 1999; 1999a; Lathrop, Maurer, & Wyman, 1997; Maislin, 2003; Ryan & Henselmeier, 2000
- sitemaps: Bernard, 1999; 1999a; Dietl, 2000; Dijck, 2000; 2000a; Dodge, 1999; Nielsen, 2002; Russel, 2002; Stams, 2002
- wizards / guides: Bollaert, 2001; 2002; Endo, McKenzie, & Arkin, 2002; Fowler & Stanwick, 1998; Sun Microsystems Inc., 2001; Welie, 2002; Scanlon, 1997; Microsoft Corporation, 1997

Interviews were audio taped using a Minidisc recorder, and further notes were taken by the interviewer, using a special interview protocol template in iteration 2 (see Appendix B-1.1).

In the first iteration, the interview concentrated on three major task scenarios and respective overall problems the interviewee experienced in performing these tasks: (1) integrating new content objects within an existing content structure, (2) defining a new category, and (3) organizing categories (see Appendix B-1.1). For each scenario, interviewees were asked to describe instances of how they solved these tasks in the past, and any problems experienced throughout. No further questions were pre-defined in the interview script, in order to allow for a broad and adaptive treatment of the issues that came up.

In the second iteration, only one scenario was analyzed: adding a new “Knowledge Object” to the Siemens ShareNet (i.e., adding a description of a problem solution or the like to the knowledge database). This time, more than 25 predefined questions (see Appendix B-1.1) focused on potential problems caused by any one component of the IA System Model V0.1. Interviewees were requested to describe an instance of how they performed the task in the past, and subsequently, were asked whether and if so how a particular IA system component had influenced their performance. Thus, the interview method in iteration 2 was much more structured, in order to allow for amplification and refinement of the findings in iteration 1.

For adequate selection of interviewees in both iterations, requirements were defined in a recruiting profile. Thus, interviewees had to have experience in one or more of the following:

- R1: Developing, managing, and revising the Content Management (CM) Process
- R2: Authoring new information and documents
- R3: Integrating new information and documents through the CM-System
- R4: Administrating and applying metadata
- R5: Administrating category structures
- R6: Integrating site growth and change
- R7: Administrating portal applications

Interviewee recruiting was performed on the phone, using a recruiting script covering these requirements (see Appendix B-1.1). For iteration 1, interviewee recruitment relied on established contacts between the author’s department and departments responsible for managing the SEP’s content. Potential interviewees for iteration 2 were selected based on server log data of the Siemens ShareNet, in order to identify users who added at least one “Knowledge Object” within the last 12 months to the ShareNet. All interviews took place at different sites of Siemens within Munich / Germany.

Data analysis started with preparing the raw data. For the SEP usability evaluation results, 12 single spreadsheet and word processor files containing the detailed usability problems found were checked for redundancies. The interview recordings were completely transliterated and enhanced with the notes taken by the interviewer where necessary. The analysis of data was again performed using qualitative content analysis (see 2.2.6.1). However, unlike the inductive category development of the previous step, here these earlier defined categories (the IA System Model V0.1) were deductively applied (and thereby validated) to classify the deficiencies of IA system instances. Thus, the procedure included the following basic steps (compare with Figure 2-19, Page 67, right diagram):

1. Defining the research question
2. Specifying main and sub-categories
3. Developing a coding guide: creating category definitions, key examples
4. Coding the text material and revising categories

(1) The research question for the analysis was, “*To which IA System (sub-) components can a given problem be traced back?*” Thus, the *analysis unit* was a description of a single problem end users or content providers experienced. The *coding unit*, however, was defined as the part of an analysis unit that named the aspect of an information system that caused the problem.

(2), (3) Main and sub-categories for the analysis were specified according to the IA System Model V0.1 components. Definitions of categories and key examples, where necessary, were created (see Appendix B-1.2).

(4) Coding the text material, then, involved assigning each problem to one of the existing system components, thereby validating these. For each problem not adequately re-traceable to an existing component, either a new component was defined, or existing components were re-grouped, re-named, or re-defined, thereby revising and detailing the IA System Model. As the components were derived from earlier research (see 4.1.2), and again were validated in a subsequent step (see 4.1.5.3), no additional test of reliability of results was performed.

4.1.3.3 Results: IA System Model V0.2: Deficiencies of Components

IA System Model V0.2: Revised Components

As a secondary result of the analysis of deficiencies of IA system components, the components defined in the IA System Model V0.1 were validated and revised for V0.2 (see Figure 4-5). Thus, component (1) was re-labeled “Content Framework”, and additional sub-components Granularity, Media type, and Functionality were defined. Page layout was added

as third sub-component of component (2) Organization Systems. Components (3) and (4) were consolidated by clustering sub-components to two main sub-components each (3.1 Embedded navigation systems, 3.2 Supplemental navigation system, and 4.1 Search fields & zones, search thesaurus, 4.2 Search interface). Component (5), Labeling Systems, was re-located spanning the remaining four main components horizontally, thus defining its four sub-components (5.1 Labels for headings, 5.2. Labels for metadata / content structure elements, 5.3 Labels for navigation elements, and 5.4 Labels for search thesaurus elements; for preliminary definitions of components, see Appendix B-1.3).

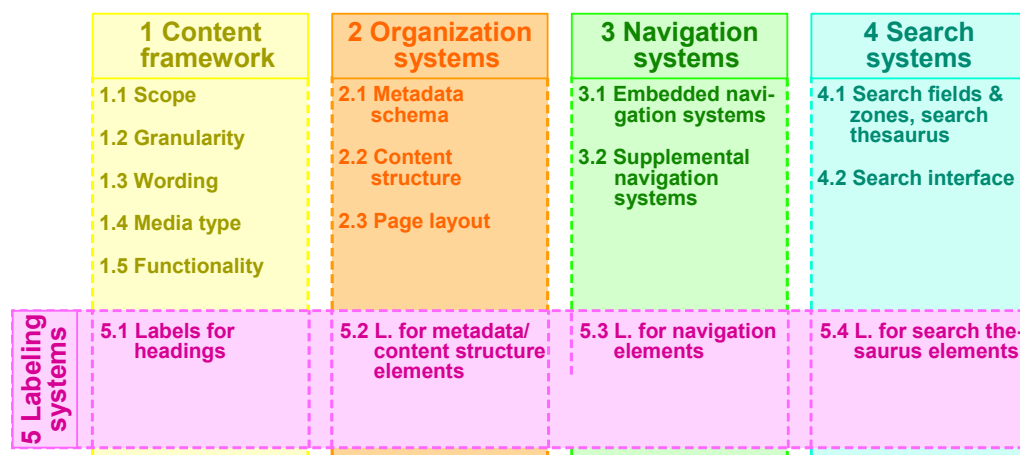


Figure 4-5: IA System Model, V0.2: revised IA system components

IA System Model, V0.2: Deficiencies of IA System Components

The analysis yielded more than 900 individual instances of IA system-related problems and requirements affecting end users or content providers in their everyday tasks. Each of these instances could be attributed to one or more components of the IA System Model identified in the previous step, thereby clustering these deficiency instances to 80 generic IA system deficiencies. These results confirmed the suspected strong impact IA systems exert both on end users but especially also on content provider goal achievement. Table 4-1 lists generic IA system deficiencies for end users (column 2) and content providers (column 3). A list of definitions for individual deficiencies is given in Appendix B-1.2.

Table 4-1: IA System Model, V0.2: deficiencies of IA system components

IA system component	End user problems	Content provider problems
Content framework		
Content scope	<ul style="list-style-type: none"> missing content unwanted/outdated content 	<ul style="list-style-type: none"> responsibility/content/constraints-dependent need for user-focus, unclear user needs need for restricted user access to content
Content granularity	<ul style="list-style-type: none"> too coarsely grained too finely grained 	<ul style="list-style-type: none"> responsibility/content/constraints-dependent need for user-focus, unclear user needs

Content wording	<ul style="list-style-type: none"> ▪ inadequate level of language ▪ inconsistent terminology ▪ unclear abbreviations ▪ unclear expressions/terms ▪ wrong language ▪ wrong spelling 	<ul style="list-style-type: none"> ▪ responsibility/content/ constraints-dependent ▪ need for user-focus, unclear user needs
Content media type	<ul style="list-style-type: none"> ▪ unwanted/wrong media type 	<ul style="list-style-type: none"> ▪ responsibility/content/ constraints-dependent ▪ need for user-focus, unclear user needs
Content functionality	<ul style="list-style-type: none"> ▪ missing functionality ▪ unwanted functionality ▪ unclear functionality ▪ unexpected behavior 	
Organization systems		
Metadata systems (incl. attributes, Content Type Classes)		<ul style="list-style-type: none"> ▪ constraints (time/money) impede classification ▪ missing attributes ▪ unwanted attributes ▪ need for Content Type Classes ▪ inadequate distinction mandatory/optional ▪ inadequate formats for single attributes
Value Range (VR)		<ul style="list-style-type: none"> ▪ missing VR ▪ unwanted VR ▪ missing values for an attribute (non-exhaustive) ▪ too finely grained value range ▪ need for being able to propose missing values ▪ need for multi-selection
Content structure		<ul style="list-style-type: none"> ▪ hierarchy too deep ▪ inadequate location regarding own requirements
Criterion		<ul style="list-style-type: none"> ▪ inadequate criterion ▪ instable categorization ▪ unclear allocation of responsibilities
Categories		<ul style="list-style-type: none"> ▪ missing categories (not exhaustive) ▪ too coarsely grained category range ▪ too finely grained category range ▪ need for multi-selection ▪ need for being able to propose missing categories
Layout (page organization)	<ul style="list-style-type: none"> ▪ complex layout, too much page elements ▪ inconsistent layouts ▪ layout & screen interaction ▪ page elements not salient enough ▪ inadequate separation/aggregation of page elements ▪ too few page elements (no missing content specified) ▪ inadequate typeface 	<ul style="list-style-type: none"> ▪ responsibility/content/constraints-dependent ▪ need for user-focus, unclear user needs ▪ unwanted/missing page elements ▪ not enough screen space for single page elements ▪ resulting layout not consistent with pre-viewed layout
Navigation systems	<ul style="list-style-type: none"> ▪ missing navigation choices ▪ unwanted navigation choices ▪ unexpected navigation paths 	
Embedded navigation systems		
Global/local navigation	<ul style="list-style-type: none"> ▪ missing navigation choices ▪ unwanted navigation choices 	
Contextual navigation	<ul style="list-style-type: none"> ▪ missing navigation choices 	<ul style="list-style-type: none"> ▪ need for contextually linking content
Supplemental navigation systems		
Guides/wizards	<ul style="list-style-type: none"> ▪ forced to leave wizard to answer 	

	<ul style="list-style-type: none"> question missing overview (roadmap) no alternative for experienced users available inadequate step-by-step guidance too many screens unclear purpose 	
Site maps/TOCs	<ul style="list-style-type: none"> inadequate level of detail out of date need for doubled entries 	
Indexes	<ul style="list-style-type: none"> inadequate index structure missing synonyms handling no substantive information for entries too many page numbers for a single entry 	<ul style="list-style-type: none"> constraints (time/money) impede indexing need for adequately incorporating content in an index
Search systems		
Search engine	<ul style="list-style-type: none"> insufficient response time insufficient search results unclear functionality 	
Search zones / search fields	<ul style="list-style-type: none"> missing search zones 	
Search thesaurus	<ul style="list-style-type: none"> inadequate synonym expansion no correction of misspellings 	
Search interface		
Search query input	<ul style="list-style-type: none"> missing functionalities unwanted functionalities 	
Search results display	<ul style="list-style-type: none"> hits insufficiently described layout problems missing functionalities 	
Labeling systems (Controlled Vocabularies)		
labels for headings	<ul style="list-style-type: none"> unrepresentative headings 	
labels for Metadata attributes / values		<ul style="list-style-type: none"> unclear scope of attributes unclear scope of values unclear scope of categories
labels for navigation elements	<ul style="list-style-type: none"> inconsistent label use misleading labels non-predictive labels 	
labels for search thesaurus elements		<ul style="list-style-type: none"> (see Metadata systems)

4.1.4 Step 1.3: Optimum Values for IA System Components

4.1.4.1 Outline and Objectives

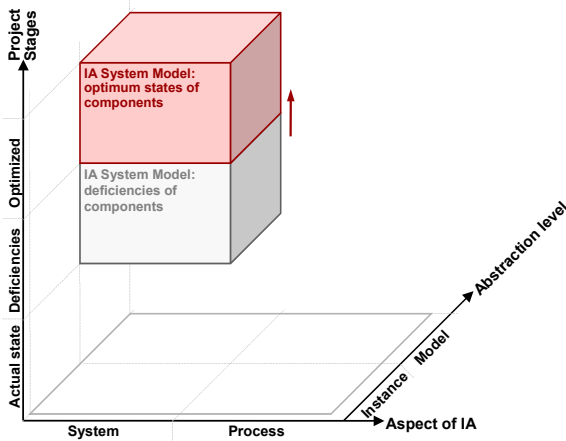


Figure 4-6: Visualization of step 1.3

Outline: Based on the IA System Model V0.2 on deficiencies of IA system components, optimum values for IA system components are derived, thereby developing a model of optimum IA systems (the IA System Model V0.3).

Objectives: describing an optimum state of IA systems, in order to define target states of IA process deliverables, and thus, goals to be met by IA processes.

4.1.4.2 Methods and Materials

This step basically involved re-wording the deficiencies identified in the previous step in terms of requirements for an optimum IA system. Each requirement thus specifies the positive counterpart of the respective deficiency.

4.1.4.3 Results: IA System Model V0.3: Optimum Values for Components

No changes were made to the components of the IA System Model V0.3 compared to V0.2, and thus, Figure 4-5 (Page 121) is not repeated here. Table 4-2 shows the optimum values defined for each IA system component.

Table 4-2: IA System Model, V0.3: optimum values for components

IA system component	End user requirements	Content provider requirements
Content framework		
Content scope	<ul style="list-style-type: none"> no missing / unwanted / outdated content 	<ul style="list-style-type: none"> adequate freedom of decision adequate alignment with user needs adequate restriction of user access to content
Content granularity	<ul style="list-style-type: none"> adequate granularity 	<ul style="list-style-type: none"> adequate freedom of decision adequate alignment with user needs
Content wording	<ul style="list-style-type: none"> adequate level of language consistent terminology clear abbreviations clear expressions/terms appropriate language correct spelling 	<ul style="list-style-type: none"> adequate freedom of decision adequate alignment with user needs
Content media type	<ul style="list-style-type: none"> appropriate media type 	<ul style="list-style-type: none"> adequate freedom of decision adequate alignment with user needs
Content functionality	<ul style="list-style-type: none"> no missing / unwanted functionality clear functionality behavior as expected 	<ul style="list-style-type: none">

Organization systems		
Metadata systems (incl. attributes, Content Type Classes)		<ul style="list-style-type: none"> ▪ quick and easy application of metadata ▪ no missing attributes ▪ no unwanted attributes ▪ adequate Content Type Classes ▪ adequate distinction mandatory/optional ▪ adequate formats for single attributes
Value Range (VR)		<ul style="list-style-type: none"> ▪ no missing / unwanted VR ▪ no missing values for an attribute (non-exhaustive) ▪ adequate granularity of VR ▪ possible to propose missing values ▪ multi-selection of values possible
Content structure		<ul style="list-style-type: none"> ▪ adequate depth of the hierarchy ▪ adequate location regarding own requirements
Criterion		<ul style="list-style-type: none"> ▪ adequate criterion ▪ stable categorization ▪ clear allocation of responsibilities
Categories		<ul style="list-style-type: none"> ▪ no missing categories (exhaustive) ▪ adequate granularity of category range ▪ multi-selection of values possible ▪ possible to propose missing categories
Layout (page organization)	<ul style="list-style-type: none"> ▪ clear layout ▪ consistent layout ▪ concerted interaction of layout & screen ▪ all page elements visible ▪ appropriate separation/aggregation of page elements ▪ adequate amount of page elements ▪ appropriate typeface 	<ul style="list-style-type: none"> ▪ adequate freedom of decision ▪ adequate alignment with user needs ▪ no missing / unwanted page elements ▪ adequate screen space for single page elements ▪ resulting layout consistent with previewed layout
Navigation systems	<ul style="list-style-type: none"> ▪ no missing / unwanted navigation choices ▪ navigation paths as expected 	
Embedded navigation systems		
Global/local navigation	<ul style="list-style-type: none"> ▪ no missing / unwanted navigation choices 	
Contextual navigation	<ul style="list-style-type: none"> ▪ no missing navigation choices 	<ul style="list-style-type: none"> ▪ possible to contextually link content
Supplemental navigation systems		
Guides/wizards	<ul style="list-style-type: none"> ▪ not forced to leave wizard to answer question ▪ overview available (roadmap) ▪ alternative for experienced users available ▪ adequate step-by-step guidance ▪ adequate number of many screens ▪ clear purpose 	
Site maps/TOCs	<ul style="list-style-type: none"> ▪ adequate level of detail ▪ up to date ▪ doubled entries available 	
Indexes	<ul style="list-style-type: none"> ▪ adequate index structure ▪ adequate synonym handling ▪ substantive information for entries ▪ adequate amount of page numbers for a single entry 	<ul style="list-style-type: none"> ▪ quick and easy selection of index words ▪ possible to adequately incorporate content in an index
Search Systems		
Search engine	<ul style="list-style-type: none"> ▪ satisfactory response time ▪ satisfactory search results ▪ clear functionality 	

Search zones / search fields	▪ no missing search zones	
Search thesaurus	▪ Adequate synonym expansion / correction of misspellings	
Search interface		
Search query input	▪ no missing / unwanted functionalities	
Search results display	▪ hits sufficiently described ▪ adequate layout ▪ no missing functionalities	
Labeling Systems (Controlled Vocabularies)		
labels for headings	▪ representative headings	
labels for Metadata attributes / values		▪ clear scope of attributes ▪ clear scope of values ▪ clear scope of categories
labels for navigation elements	▪ consistent label use ▪ not misleading labels ▪ predictive labels	
labels for search thesaurus elements		▪ (see Metadata systems)

4.1.5 Step 1.4: Dependencies Between IA System Components

4.1.5.1 Outline and Objectives

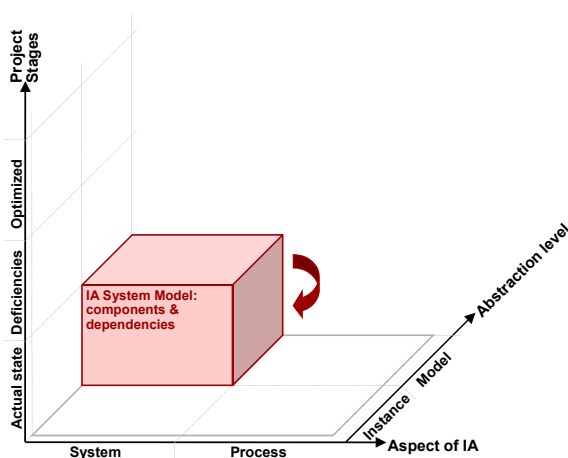


Figure 4-7: Visualization of step 1.4

Outline: Using focused expert interviews, internal and external dependencies of IA system components are identified, and the IA System Model V0.3 is validated and revised. Integrating the results into the IA System Model, V0.4 is derived. Dependencies were also obtained by reviewing respective literature.

Objectives in this step were:

- Validating and revising the IA System Model V0.3
- Identifying internal and external dependencies to which IA system components are subjected, in order to develop efficient IA process flows accounting for these.

4.1.5.2 Methods and Materials

The particular interviewing method employed in this step can be classified as *semi-structured expert interview* (see 2.2.6.1), as the interviews involved a closely circumscribed focus on the interviewees' expert knowledge of IA systems, and questions were pre-defined. The interviews focused on revising and validating the IA System Model V0.3, and on identifying internal and external dependencies. Thus, they were split into two major parts:

IA System Model Components:

The components of the IA System Model V0.3 were introduced to the interviewee by explaining the basic rationale and the definition of an IA system model, and by describing the five major components with their sub-components using paper printouts of the model (see Figure 4-8, left image). In the subsequent review phase, the leading questions were, “Can you agree on this model? Are there any missing or unnecessary components?” Interviewees were encouraged to comment on the proposed model and make suggestions for improvement.

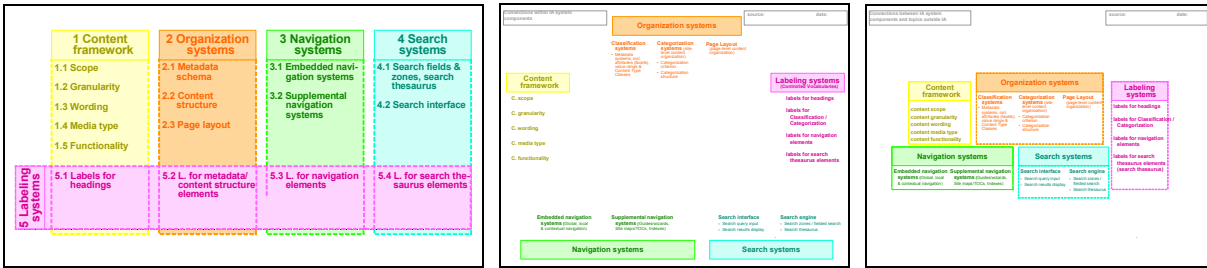
Dependencies to Which Components are Subjected:

Interviewees were asked to name both internal and external dependencies of IA system components; thus, the leading questions were, “Which dependencies can you identify for each of these components? How do the components influence each other? What major external entities or forces influence the components?” The interviews lasted approximately 1 to 2 hours, and were conducted with subject matter experts (information architects, usability engineers, and CM experts; N=4) in a one-on-one situation, face-to-face or via phone. All interviewees had a minimum of 5 years of experience in their field, confirming their expert status (see Table 4-3).

Table 4-3: Experts interviewed on IA system components and dependencies

#	Job title	Field of experience	# Yrs. of exp.	Company/ Department	Location	Interview Method
1	Information Architect	IA	5	Siemens AG / CIO	Munich / Germany	Face-to-face
2	Information Architect	IA, CM	12	Siemens AG / CIO	Munich / Germany	Face-to-face
3	Usability Engineer	UE	5	Siemens AG / SCR	Princeton / US	Phone/Internet
4	Information Architect	IA	8	Siemens AG / SCR	Princeton / US	Face-to-face

Interviewees were given templates for sketching internal and external dependencies of components. During the interviews, data was recorded both by the interviewer taking notes and by having the interviewee sketch suggested change requests to components and proposed dependencies on these templates (see Figure 4-8 and Figure 4-9).



**Figure 4-8: Stimulus material for the expert interviews:
IA system components, templates for internal and external dependencies (from left to right)**

Data analysis was performed qualitatively. For the IA System Model components, this included assembling change requests for individual components across all interviewees and extracting a common denominator, and accordingly, removing, adding, re-grouping, renaming, and re-defining (sub-) components, thereby developing the IA System Model V0.4. For dependencies, the analysis was comprised of extracting every instance of an internal or external dependency from the sketches drawn by the interviewees (see Figure 4-9) and from the notes taken by the interviewer, and recording it, together with the respective entities involved, in a spreadsheet (see Appendix B-1.4). In addition, dependencies identified in previous literature, as well as in additional research and IA projects performed by the author, were included and subsequently confirmed in expert interviews. An exemplary, fictive website was used to illustrate the components and their interplay.

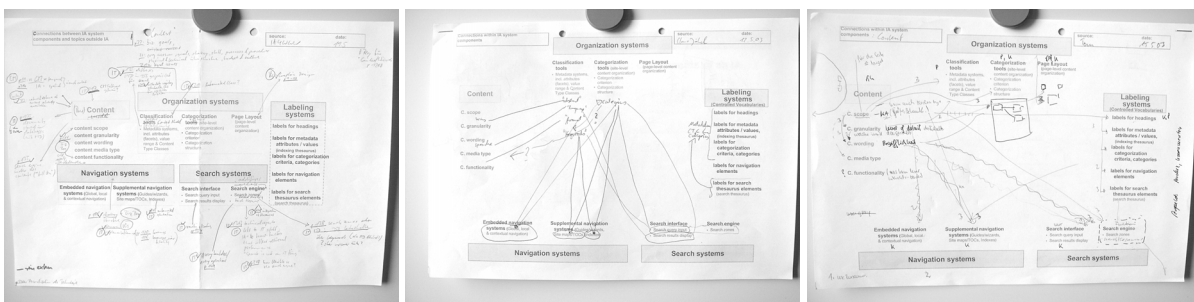


Figure 4-9: Sketches of IA system dependencies drawn by interviewees

To investigate the degree of dependence for individual IA System components, dependencies were subjected to an analysis using a software called GAMMA (“GAMMA”, 1994), which allows for analyzing the degree of influence individual elements of a system exert and sustain. For this analysis, each dependency of one element from another can be rated according to its strength (from 1 to 9; here, all dependency strengths were rated as 1). This strength value, then, is added to the influencing element’s total *active* value, and the influenced element’s total *passive* value. After summarizing across dependencies, these totals of active and passive values for each element are converted to percent values, with the highest active or passive value across all dependencies providing the base value (=100). The resulting graph shows the influencing factors positioned according to their active and passive values in the system.

4.1.5.3 Results: IA System Model V0.4: Dependencies Between Components

The review of the IA System Model V0.3 did not enforce any significant changes regarding the components of the system; while this presented a strong validation of V0.3, the diagram portrayed in Figure 4-5 (Page 121) is not replicated here. The analysis of dependencies between these validated IA system components resulted in 53 internal and 30 external depend-

encies (see Table 4-4 and Table 4-5). In these tables, for each component listed row-wise, an “x” indicates a dependency from another component listed column-wise. For detailed descriptions of what dependencies each “x” stands in for, as well as the data on the exemplary, fictive website, see Appendix B-1.4.

Table 4-4: Internal dependencies between IA system components

IA system component	IA system component																
	Content scope	Content granularity	Content wording	Content media type	Content functionality		Metadata systems	Categorization	Layout (page organization)		Embedded navigation systems	Supplemental navigation systems		Search engine	Search interface		Labels for headings
Content scope		x	x	x	x		x	x	x			x					
Content granularity			x				x	x	x								
Content wording																	x
Content media type							x										x
Content functionality				x					x		x	x					
Metadata systems								x			x	x		x	x		
Categorization											x	x		x	x		
Layout (page organization)		x									x	x		x			x
Embedded navigation systems							x	x									
Supplemental navigation systems							x										
Search engine							x								x		
Search interface														x			
labels for headings			x						x								
labels for Class/Cat			x				x	x									
labels for navigation elements			x						x		x	x					
labels for search thesaurus elements			x											x			

Note. Read: component in row... has impact on component in column... For details, see Appendix B-1.4.

The results of the analysis of the degree of dependencies are shown in Figure 4-10 and Figure 4-11 for internal and external dependencies, respectively. For internal dependencies, the most eye-catching result is the pervasive dominance exerted by Content Scope (circle 1 in the diagram), which at the same time is not influenced by any other component. Thus, within IA system components, the content’s scope is the major determinant for all other components. In sum, however, most of the components are intertwined in a complex web of dependencies, in which each one influences and is influenced by others to a significant degree.

For external dependencies (Figure 4-11), Business Strategy and Target User Group (both visualized as element B in the diagram), followed by System Development, exert the most influence on other elements of the overall information system. Out of these three, System Development is supposedly still the one most malleable, while Business Strategy and characteristics of the Target User Group are comparatively invariant factors whose significant impact on IA system components thus has to guide any IA process. Accordingly, most of the IA system components (Organization Systems [2], Navigation Systems [A], Search Systems [A], and Labeling Systems [3]), are much more passively influenced by external elements delivered by other disciplines than they are actively influencing them, which again has to be accounted for in an IA process model.

Table 4-5: External IA system components dependencies

IA system components / external entity	IA system component / external entity											
	Business Strategy	Target User Group	Content	Content Management	System Development	UID, Interaction & Graphic D.		Content Framework	Organization system	Navigation systems	Search systems	Labeling systems
Business Strategy								x	x	x	x	x
Target User Group								x	x	x	x	x
Content								x	x	x	x	x
Content Management			x					x	x			
System Development				x					x	x	x	
UID, Interaction & Graphic D.									x	x	x	
Content Framework			x	x		x						
Organization system				x		x						
Navigation systems												
Search systems												
Labeling systems												

Note. Read: component in row... has impact on component in column... For details, see Appendix B-1.4.

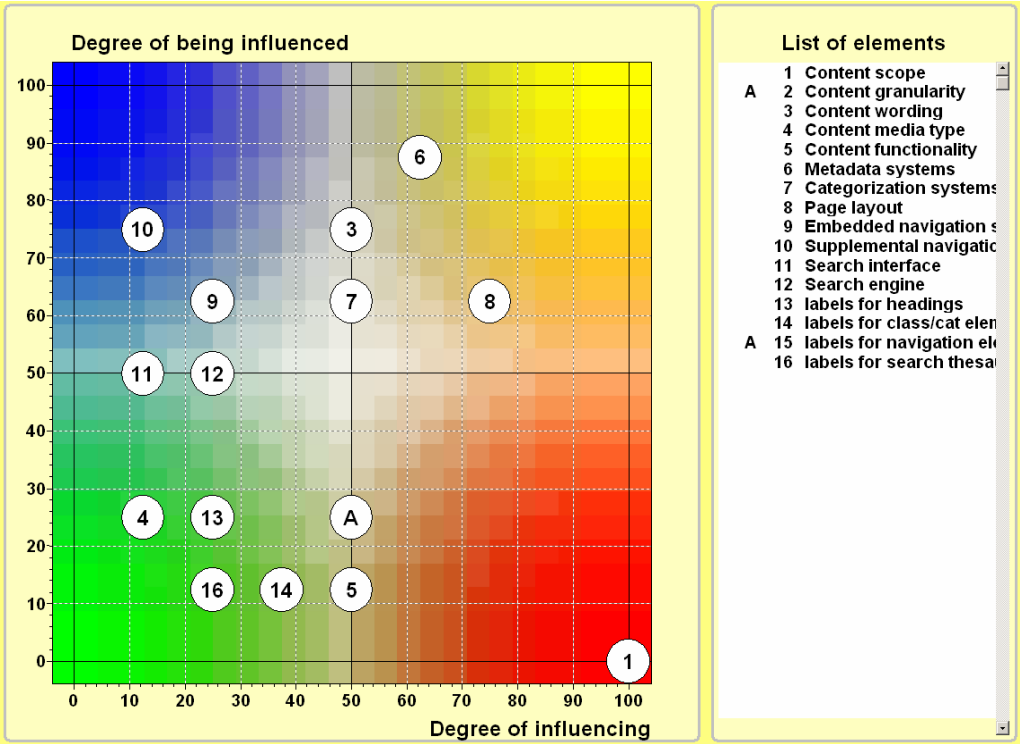


Figure 4-10: Degree of internal dependencies between IA system components (using the GAMMA software; “GAMMA”, 1994)

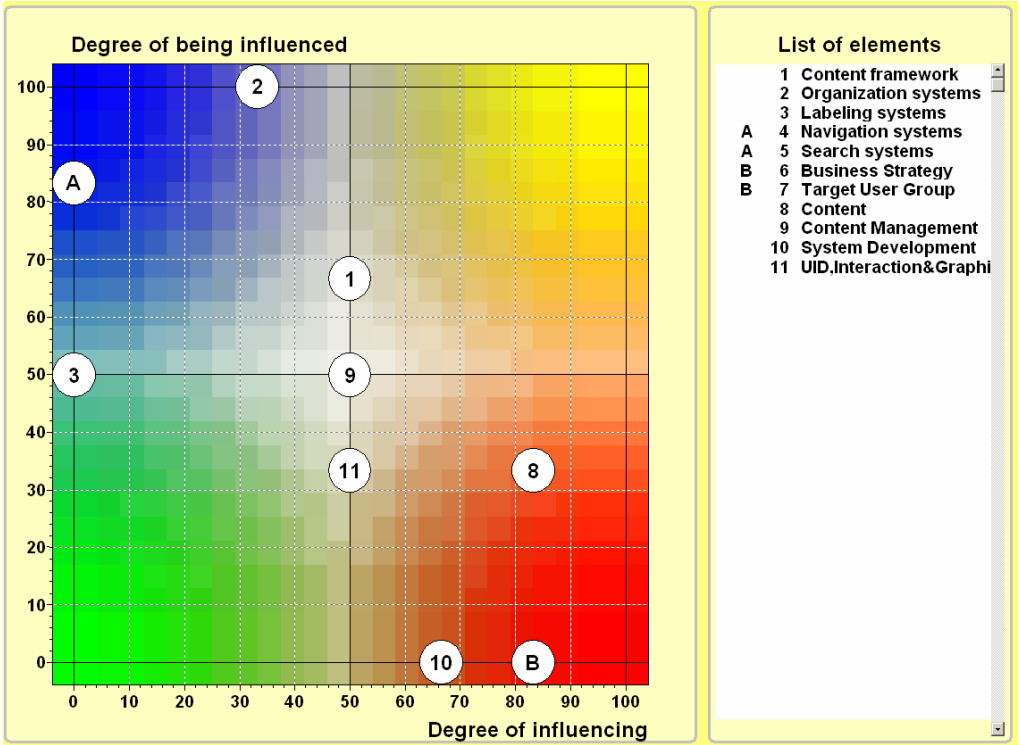


Figure 4-11: Degree of external dependencies of IA system components (using the GAMMA software; “GAMMA”, 1994)

4.2 Step 2: Process Analysis

4.2.1 Introduction and Overall Objectives

In this second overall step, the focus moved from IA systems to IA processes. It was aimed at analyzing the actual state of IA processes and respective process deficiencies, in order to be able to set up the IA process model. This involved identifying:

- the *process flow* and *process steps* of IA as currently practiced in industry (step 2.1)
- the *methods* applied in these IA processes (step 2.2)
- the *deficiencies* of these IA processes (step 2.3)

4.2.2 Step 2.1: Actual State IA Processes

4.2.2.1 Outline and Objectives

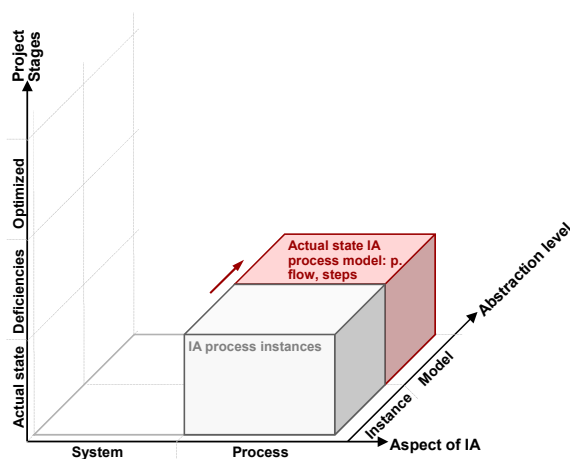


Figure 4-12: Visualization of step 2.1

Outline: From instances of current IA processes described in the literature, a model of the actual state of IA processes is induced (the IA Process Model V0.1).

Objectives: Generalizing from available IA process descriptions a highest common denominator of IA processes, including basic process flow and process steps, as a foundation for the to-be developed IA process model.

4.2.2.2 Methods and Materials

A literature review was performed on available IA process descriptions. Material for the review included 14 source documents. As before, these documents were mostly retrieved online.¹¹² The basic procedure consisted of four basic steps:

1. Collect IA process descriptions from the literature
2. Identify and enumerate single process steps according to their sequence
3. Card-sort single process step instances
4. Rearrange and enumerate consolidated process steps

¹¹² Source documents included (in alphabetical order): Bailey, 1997; Dijck, 2002; Fox, 2002; Fraser, 2002a; IconMedialab International AB, 2002; Info.Design Inc., 2002; O'Donnell, 2002; Ramsey, 2002; Rosenfeld & Morville, 2002; Shiple, 1998; Veen & Fraser, 2001; West, 1999; Zaudhaus LCC, 2003.

(1) Process descriptions were included if they focused on the development of one or more of the components included in the IA System Model V0.4.

(2) For each process description, all process steps mentioned were listed in a spreadsheet. Each process step was assigned a unique and, as far as possible, consecutive number. Whenever the name of a method was necessary to describe a process step, this method was put into squared brackets (“[]”); each deliverable necessary was put into accolades (“{}”).

(3) The resulting spreadsheet was printed on paper, cut into single process step pieces, and then an open card sorting exercise (see 2.1.5.2) was performed. Process step instances were grouped according to shared focus or objective within the process, resulting in consolidated process steps. These were then named by the most frequently used or most accepted term.

(4) Consolidated process steps were rearranged in a sequence based on the average position in the source descriptions, and according to the logical sequence of steps as laid out in the ISO 13407 and ISO TR 18529, as detailed as possible. Wherever no clear sequence could be identified, process steps were numbered identically with an “.x” indicating equal position.¹¹³

4.2.2.3 Results: IA Process Model V0.1: Actual State IA Processes

Figure 4-13 gives an overview on the IA Process Model V0.1, describing the actual state of IA processes. It shows seven major process *phases* in a linear sequence. In detail, these major process phases of the IA Process Model V0.1 were each comprised of individual process *steps* (see Table 4-6; for detailed documentation of source data, see Appendix B-2.1).

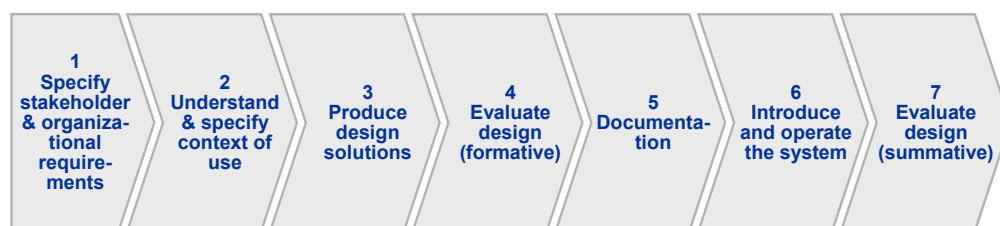


Figure 4-13: IA Process Model, V0.1: overview actual state IA process phases

Table 4-6: IA Process Model, V0.1: detailed actual state IA process steps

Detailed Actual State IA Process Model V0.1
1. Specify stakeholder & organizational requirements
1.x Specify the business' vision/mission, business concept, marketing plan, brand identity; prioritize business goals
1.x Specify site goals
1.x Specify target audience

¹¹³ For example, several sub-steps of a process step “2”, with no clear sequence between them, all were numbered “2.x”.

1.x Specify success metrics
1.x Set up cooperation with: CM (Content Management), SD (System Development), VD (Visual Design)
2. Understand & specify context of use, gather user requirements
2.x Perform competitive analysis
2.x Perform content analysis
2.x Perform user research
3. Produce design solutions
3.1 Align user & content requirements
3.2 Develop basic IA strategy
▪ Strategy for blueprints, wireframes, navigation
▪ Strategy for Metadata scheme
3.3 Prioritize features
3.4.x IA design
▪ Design of blueprints, wireframes, navigation
▪ Metadata schema design
3.4.x Develop recommendations
▪ Recommendations regarding IA-maintenance
▪ Recommendations regarding Content Management
▪ Recommendations regarding System Development
3.4.x Cooperate/ align with Usability Engineering / Visual Design
3.4.x Develop Prototypes
4. Evaluate design (formatively)
4.x Perform usability test
4.x Perform Visual Design review
4.x Perform System Development review
5. Documentation
5.x Create Visual Design documentation: Visual Style Guide
5.x Create IA maintenance documentation: Architectural Style Guide
5.x Create Content Management documentation: Content Development Guide
5.x Create System Development documentation: Functional / technical specification
6. Introduce and operate the system
7. Evaluate design (summatively)

4.2.3 Step 2.2: Methods Applied in IA Processes

4.2.3.1 Outline and Objectives

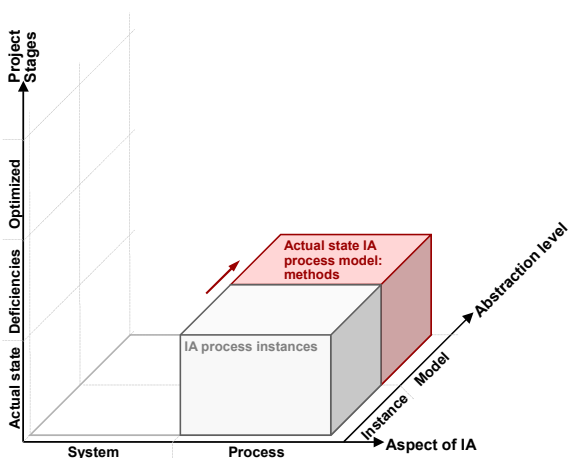


Figure 4-14: Visualization of step 2.2

Outline: From the available literature, methods applied in current IA processes are gathered, including descriptions, benefits, and shortcomings.

Objectives: assembling a collection of IA methods including relevant selection criteria, in order to increase scalability of the process model by providing a range of applicable methods for each process step to choose from.

4.2.3.2 Methods and Materials

A literature review was performed on available descriptions of IA methods. Material for the review included 75 source documents, focusing on methods related to organizing information rooted in several disciplines, including Usability Engineering, Information Architecture, Content Management, and Knowledge Management. Again, many of these documents were retrieved online.¹¹⁴ For each method, the following data was collected in a spreadsheet:

- Name (most prevalent term)
- Description of the method (including focus, scope, overall procedure, and variants)
- Benefits and shortcomings (where available)

4.2.3.3 Results: IA Process Model V0.2: Methods Applicable in IA Processes

Table 4-7 lists IA methods alphabetically, with brief descriptions of the basic procedure. For benefits and shortcomings of these methods as outlined in the literature, see Appendix B-2.2. Both Table 4-7 and Appendix B-2.2, however, only include methods relevant to the subsequent development of the IA process model. Additional methods, which initially were taken account of, but subsequently were dropped from the analysis, are not listed to increase readability. Between some methods, there are close relationships (e.g., Contextual Inquiry and Task Analysis); although these are indicated in Table 4-7 as far as they were described in the literature, it was not within the focus of this step to describe them exhaustively.

Table 4-7: IA methods as described in the literature

Method	Description / Variants
Affinity Diagramming	Affinity diagramming simply consists of placing related items together. Although this can be done electronically for very small sets of data (using a word processor or spreadsheet program), it is better to work with paper. In group situations, always use paper.
Best Practice/Competitive Analysis	Review of the research literature; "professional judgment" usability review of any competitor software, user interfaces, or e-commerce sites.

¹¹⁴ Source documents included (in alphabetical order): Abrol et al., 2001; Adams, 2001; Austin Usability, 2002; Autonomy Inc., 2000; Bevan & Thomas, 1999; Bias, 1994; Boiko, 2002; Brown, D., 2002; U.S. Department of Health and Human Services, n.d.; Cooley, 2000; Cooley, Mobasher, & Srivastava, 1997; Cunliffe et al., 2002; Daly-Jones et al., 1999; User Interface Engineering Inc., 2002; Drott, 1998; Dumais & Chen, 2000; Fraser, 2002; Fuccella & Pizzolato, 1999; 1999a; Fuccella et al., 1999; Fuller & de Graaff, 1996; Gaffney, 1999; 1999a; 1999b; 1999c; 2000; 2000a; 2000b; 2001; 2002; Goodwin, 2002; Gordon, 2002; Gutierrez & Ritzie, 2000; Hagedorn, 2001; Hill, 2000; Hom, 1996; Instone, 2002; Karat, 1994; Kosala & Blockeel, 2000; Kuniavsky, 2002; Lafrenière, 1996; Larson & Czerwinski, 1998; Levi & Conrad, 2001; Maguire, 1998; Maurer, 2003; Mayhew, 1999; Morville, 2000; Muller, 1993; Muller, Wildman, & White, 1993; Myer, 2002; Nielsen, 1993; 1997a; Nielsen & Mack, 1994; Nielsen & Sano, 1994; Ojakaar & Spool, 2001; Rhodes, 2001; 2001a; 2002; Robertson, 2002; 2002a; Rosenfeld, 1998; Rosenfeld & Morville, 2002; Rubin, 1994; Seybold, 2001; Shiple, 1998; Sisson, 1999; Delphi Group, 2001; Veen, 2002a; Veen & Fraser, 2001; Verity Inc., 2002; Vora, 1998; Wang, 2000; Wharton et al., 1994; Wodke, 2001; Wodtke, 2002; Yu, Prabhu, & Neal, 1998.

Card Sorting	This is a method for discovering the latent structure in an unsorted list of statements or ideas/content elements. The investigator writes each item on a small index card and requests six or more informants to sort these cards into groups or clusters, working on their own. The results of the individual sorts are then combined and if necessary analyzed statistically.
Consolidated Assessment	Combination of scenario design, card sorting, and participatory design into one session
Content Inventory	It is a complete list of all the content that the site holds and will hold. Most typically used for content rather than application sites. The content inventory may be provided by the IA or the client.
Contextual Inquiry	Contextual Inquiry is a technique for examining and understanding users and their workplace, tasks, issues and preferences. Consists of visiting several representative users on site, observing them carrying out their tasks, asking questions, and analyzing and documenting the resultant data. Contextual enquiry may also be referred to as user needs/task analysis; however, the scope is somewhat more design-focused.
Critical Incident Technique	End users are asked to identify specific incidents that they experienced personally, and which had an important effect on the outcome. The emphasis is on incidents rather than vague opinions. The context of the incident may also be elicited. Data from many users is collected and analyzed.
Diary keeping	Activity diaries require the informant to record activities they are engaged in throughout a normal day. Diaries may vary from open-ended, where the informant writes in their own words, to highly structured tick-box forms, where the respondent gives simple multiple choice or yes/no answers to questions. The required materials range from paper and pencil techniques, to video tape diaries and on-line input forms administered by computer.
End User Feedback Analysis	Analysis of support call and guest book data
Field study	Observational methods involve an investigator viewing users as they work in a field study, and taking notes on the activity that takes place. Observation may be either direct, where the investigator is actually present during the task, or indirect, where the task is viewed by some other means such as through use of a video recorder. The method is useful early in user requirements specification for obtaining qualitative data. It is also useful for studying currently executed tasks and processes.
Focus Group	Brings together a cross-section of stakeholders in the context of a facilitated but informal discussion group; often used to identify initial requirements with users, or to discuss new ideas, design options, costs and benefits, screen layouts etc., when relevant to the design process.
Free Listing	Free listing is a semi-structured method. It can be conducted as part of an interview, or as a written exercise (and can be done online as well). Simply ask the respondent, "Name all the x's you know." Frequency and rank of items mentioned by several respondents are statistically analyzed.
Functionality matrix	This process specifies the system functions that each user will require for the different tasks that they perform. The most critical task functions are identified so that more time can be paid to them during usability testing later in the design process. It is important that input is obtained from different user groups in order to complete the matrix fully.
Group discussion	Group discussions are based on the idea of stakeholders within the design process discussing new ideas, design options, costs and benefits, screen layouts etc., when relevant to the design process. Group discussions help to summarize the ideas and information held by individual members. The general idea is that each participant can act to stimulate ideas in the other people present, and that by a process of discussion, the collective view becomes established which is greater than the individual parts.
Interface Design Patterns	Interface design patterns are solutions to frequently occurring problems and situation in the design of interfaces. The end users and the implementation teams conceptualize the interfaces in terms of interface design patterns.
Interview	Users are interviewed and asked to give their views on the products usability; Talking with one user at a time (for 30 minutes to an hour) face to face or by telephone or with instant messaging or other computer-aided means Domain experts or less experienced users are asked questions by an interviewer in order to gain domain knowledge. 3 types: unstructured interviews, semi-structured interviews and structured interviews

Log File Analysis	Application of data mining techniques to discover usage patterns from Web data (Server Log Data, Search Log Data), in order to understand and better serve the needs of Web-based applications.
Parallel design	Parallel design is a method where alternative designs, often interface designs, are created by two to four design groups at the same time. The aim is to assess the different ideas before settling on a single concept for continued development. The design groups work independently of each other, since the goal is to generate as much diversity as possible. Design groups should not discuss their designs with each other until after they have produced their draft design concepts and presented them in a design workshop. The final design may be one of the designs or a combination of designs, taking the best features from each.
Participatory Design	A Participatory Design (PD) workshop is one in which developers, business representatives and/or users work together to design a solution.
Prioritization exercise	Make a "Big List of Things To Do". Organize your list according to dependencies and baseline items. Have the appropriate coworkers score each item (technical feasibility, creative feasibility, importance to the user, and importance to the business). Graph the overall scores.
Prototyping	A prototype is a model of the system being developed.
Paper Prototyping	This method features the use of simple materials and equipment to create a paper-based simulation of an interface or system with the aim of exploring user requirements.
Video Prototyping	This method allows designers to create a video-based simulation of interface functionality using simple materials and equipment. Interface elements are created using paper, pens, acetates etc. For example, a start state for the interface is recorded using a standard camcorder. The movements of a mouse pointer over menus may then be simulated by stopping and starting the camcorder as interfaces elements are moved, taken away and added. Users do not directly interact with the prototype although they can view and comment on the completed video-based simulation.
Computer-based (Rapid) Prototyping	This method supports the development and exploration of different design concepts through software prototypes. This form of prototyping has grown increasingly popular with the advent of rapid prototyping tools and development environments, which make it relatively simple to create a simulation of a proposed system.
Wireframe Prototyping	A wire frame is a simple HTML model of a proposed a Web site. Its primary purpose is to identify the navigation scheme and location of content within the site. In order to keep the design as simple as possible and to allow for rapid iterations, few if any visuals are used within the wire frame.
Questionnaire	A set of questions for obtaining information from individuals
Scenarios, scenario design	A scenario is a description of a person's interaction with a system. They offer concrete representations of a user working with a computer system in order to achieve a particular goal. Scenarios may be developed with users to establish how they would like or not like to interact with the system (in general terms).
Storyboarding	A storyboard is a low fidelity prototype consisting of a series of screen sketches. They are used by designers to illustrate and organize their ideas and obtain feedback. They are particularly useful for multi-media presentations.
Survey	Administering a set of questions to a large sample population of users. Two types of questions: 'closed', where the respondent is asked to select from available responses and 'open', where the respondent is free to answer as they wish.
Task Analysis	Study of what a user is required to do in terms of actions and/or cognitive processes to achieve a task. Gain access to real users to discuss their current or possible future tasks as well as user representatives.
Task Allocation charts	Task allocation decisions determine the extent to which a given job, task, function or responsibility is to be automated or assigned to a human. The decisions are based on many factors, such as relative capabilities and limitations of human versus technology in terms of reliability, speed, accuracy, strength, flexibility of response, cost, and the importance of successful or timely accomplishment of tasks.
Usability Context Analysis	Usability Context Analysis is a structured method for eliciting detailed information about a product and how it will be used, and for deriving a plan for a user based evaluation of a product. In this method stakeholders attend a facilitated meeting to detail the actual circumstances (or intended use) of a product.
(Usability) Inspection	1-2 analysts review aspects of the system.
Heuristic evaluation	Usability experts review a design based on their knowledge of human cognition and general user interface design "rules of thumb".

Guideline reviews	An interface is inspected for adherence to some list of general user interface guidelines.
Standards inspections	An expert in the relevant user interface standard (W95...) checks an interface design for adherence to those standards.
Formal Usability inspection	A formal review of the tasks that users will complete when using the product; formal definition of roles and tasks for the evaluation process
Consistency inspections	Representatives from the user interface design teams from different products within a product family inspect the design of a new product user interface to ensure consistency across the product family
Human performance models (GOMS)	GOMS: family of techniques proposed by Card, Moran, and Newell (1983), for modeling and describing human task performance
(Usability) Test	Representative users are asked to perform tasks with the prototype to help clarify the details of a user requirements specification.
Performance measurement	Performance testing is a rigorous usability evaluation of a working system under realistic conditions to identify usability problems and to compare measures such as success rate, task time and user satisfaction with requirements.
Co-operative evaluation	This is a cost-effective technique for identifying usability problems in prototype products and processes. Users work with a prototype as they carry out tasks set by the design team. During this procedure, users explain what they are doing by talking or 'thinking-aloud'. An observer records unexpected user behavior and the user's comments regarding the system. The observer also actively questions the user with respect to their intentions and expectations.
Wizard of Oz technique	This variant of computer-based prototyping involves a user interacting with a computer system that is actually operated by a hidden developer - referred to as the 'wizard'. The wizard processes input from a user and simulates system output.
Perceived IA Test	After a user has been widely exposed to the web site or prototype, the user is provided with the opportunity to illustrate the structure of the web site. They are given a large sheet of paper and a lot of different colored pens and markers. They do not have access to the web site or software at this time. Users are free to express their knowledge any way they want. They can use boxes, words, labels, words, colors, or anything else they want to display their knowledge visually.
Structure evaluation	The Structure is presented to the user with sheets of paper on a table; on the reverse of each sheet is the list of items that the structure element contains. A participant is presented with an index card representing an item: The participant attempts to locate the item in the structure
Card-based classification evaluation	For one scenario, the participant is presented an index card with a list of the first level navigation items. The participant chooses an element that he would follow to complete the task of the scenario, then he is presented an index card with the second level navigation items for the first level element he has chosen, then he again chooses,...
User Profile Analysis/ Persona Development	Persona: A fictitious person for whom you are designing; represents the archetypal qualities of your audience
Walkthrough	A walkthrough is a process of going step by step through a system design getting reactions from relevant staff, typically users. Normally one or two members of the design team will guide the walkthrough, while one or more users will comment as the walkthrough proceeds
Pluralistic Walkthrough	user, developers, and usability experts step through a design together based on a test task, discussing usability issues as they arise
Cognitive Walkthrough	the analyst simulates a user's problem-solving process at each step in carrying out a task scenario on a given user interface design to analyze it for usability successes and failures
Usability Walkthrough	Users, developers and usability specialists review a set of designs individually, and then meet to discuss each element of the design in turn.
Workshop	
Brainstorming	Brainstorming is one of the oldest known methods for generating group creativity. A group of people comes together and focuses on a problem or proposal. There are two phases of the activity. The first phase generates ideas, the second phase evaluates them. An experienced facilitator is useful.
Stakeholder meeting	A stakeholder meeting is a strategic way to derive usability objectives from business objectives, and to gain commitment to usability. It also collects information about the purpose of the system and its overall context of use.

4.2.4 Step 2.3: Deficiencies of IA Processes

4.2.4.1 Outline and Objectives

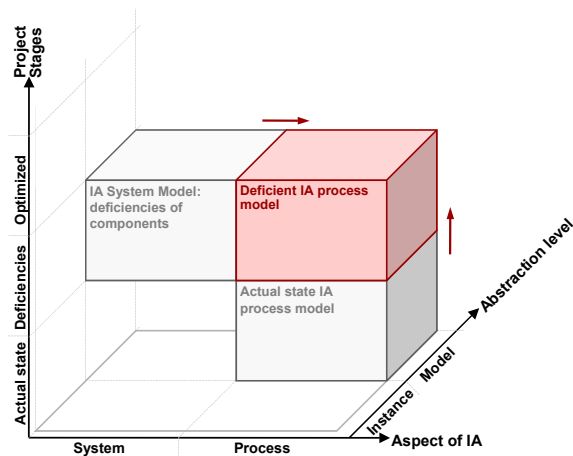


Figure 4-15: Visualization of step 2.3

Outline: Based on the IA System Model V0.2 of deficient IA systems, and the IA Process Model V0.1 of actual state IA processes, a model of deficient IA processes is derived (the IA Process Model V0.3).

Objectives: Identifying deficiencies of IA processes, in order to be able to develop an optimized IA process model that avoids or minimizes the impact of those process deficiencies.

4.2.4.2 Methods and Materials

The material for this analysis included the IA System Model V0.2 on deficient IA systems and the IA Process Model V0.1 on actual state IA processes. The basic rationale for the analysis was, “For each of the system deficiencies, what process steps can contribute to it?” Thus, the basic procedure involved identifying, for any given system deficiency (as listed in the IA System Model V0.2), if a particular process step (as listed in the IA Process Model V0.1) could contribute to this system deficiency’s emergence. Ratings were two-staged:

- Main determinant: a process step which, in most cases, will be the main contributor
- Co-determinant: a process step which might additionally contribute to the deficiency

Ratings were based on the results from the previously performed literature reviews on IA systems and processes, and from research and projects conducted at Siemens’ User Interface Design Center. Three types of potential process deficiencies (PD) were focused on:

Process Deficiencies:

PD1: Missing process steps in current IA processes (absence of a process step that is actually necessary to address a specific system deficiency)

PD2: Insufficient focus and scope of current process steps (a process step intended to address a system deficiency is not sufficient in focus and scope to do so)

PD3: Unaccounted-for dependencies between current process steps (either by not translating a dependency between process steps into an appropriate temporal sequence of steps or by not explicitly linking both process steps within the overall process flow in terms of mutual input / output delivery)

A process step was only rated as contributing to a system deficiency if it originally caused the deficiency or added to its extent; a mere “passing on” of a deficiency inherited from previous process steps was not seen as sufficient to be rated as contributing.¹¹⁵

Additional deficiencies of IA processes, which had been identified in previous literature reviews on IA systems and processes (steps 1.1., 1.2, 2.1, and 2.2), were also included. Initially, expert validations of these results were planned. However, because of the huge amount of resources involved and the unavailability of experts in the respective period, expert validations could not be performed immediately. Thus, validation had to be deferred to subsequent expert evaluation focus groups of the resulting process model (see 4.6).

4.2.4.3 Results: IA Process Model V0.3: Process Deficiencies

Table 4-8 shows which process step (as listed in Table 4-6) can contribute to a specific system deficiency (relevant to both end users (EU) and content providers (CP), as listed in Table 4-1). Process steps are listed column-wise, while system components are listed row-wise. Each “xx” or “x” at the intersection of a specific IA system component and IA process step denotes a main or co-determining effect of this process step to deficiencies related to this system component, respectively. For detailed results listing individual system deficiencies, see Appendix B-2.3. If the analysis showed that a process step is entirely missing which is actually necessary to address a specific system deficiency, this step was subsequently included in the list of process steps in brackets and italics, and ratings were added likewise. Altogether, three new process steps were thus added (“2.x Perform Content Provider [CP] Research”, “3.1.x Align CP model & Content Model”, and “4.x Perform CP review / UT”).

While these results present a strong indication of which IA process step contributes to a specific IA system deficiency, it is not possible to infer from Table 4-8 what actually is done insufficiently in a given process step. Due to resource limitations, this was not stated explicitly for each of the system deficiencies. To give one detailed example, however, Table 4-9 shows the detailed contribution of process step deficiencies to the system deficiency “missing navigation choices” (see also Appendix B-2.3).

¹¹⁵ Exemption: for all process steps with a focus on evaluation / validation of previous results, detecting deficiencies is the main reason to perform them; therefore, a deficiency missed in the evaluation is indeed seen as an original contribution to the deficiency.

Table 4-8: IA Process Model, V0.2: IA process deficiencies contributing to IA system deficiencies

User group	IA system component	IA process step																								
		1				2			3							4			5			6	7			
		1.x Specify BIZ	1.x Specify site goals	1.x Specify target audience	1.x Specify success metrics	1.x Set up coop. with stakeholders	2.x Perform Competitive Analysis	2.x Perform Content Analysis	2.x Perform End User Research (2.x Perform CP Research)	3.1.x Align EU model & Content model (3.1.x Align CP model & Content model)	3.2 Develop basic strategy	3.3 Prioritize features	3.4.x Design IA	3.4.x Develop rec.: IA-Mnt., CM & SD	3.4.x Coop./ Align with UID / VD	3.4.x Prototyping	4.x Perform Usability Tests (4.x Perform CP review / UT)	4.x Perform VD Review	4.x Perform SD Review	5.x Develop: Arch. Style Guide	5.x Develop: Visual Style Guide	5.x Develop: CM Guide	5.x Develop: Func./ tech. Spec	6. Implement / consult IA implementation	7. Measure success (metrics)	
Content Framework																										
EU	Content scope	x					x	x		xx		xx		xx	x		x				x		x		x	
CP	Content scope						x	x	x	xx	xx	xx		xx	xx		x	x				x				
EU	C. granularity	x					x	x		xx		xx		xx	x		x					x		x		
CP	C. granularity						x	x	x		xx	xx		x	xx			x				x				
EU	C. wording						x	x				xx		xx	xx		x					x		x		
CP	C. wording						x	x	x		x	xx		xx	xx			x				x				
EU	C. media type						x	x		x		xx		xx	x		x					x		x		
CP	C. media type						x	x	x		x	xx		xx	xx			x				x		x		
EU	C.functionality	x						x		x		xx		xx	x	xx		x				x		x	x	
Organization Systems																										
CP	Metadata sys.						x		x		xx	xx		xx				x				x		x		
CP	Value Range						x		x		x			xx	xx			x			x		x		x	
CP	C. structure						x		x		xx	xx		xx				x								
CP	- Criterion						x		x		xx	xx		xx	xx			x				x				
CP	- Categories						x		x		xx			xx	xx			x			x		x			
EU	Layout							x						xx		xx		x			x	x	x	x	xx	
CP	Layout						x		x					xx	xx	xx		x				x				
Navigation Systems																										
EU	Global/local n.						x	x		xx				xx				x							x	
EU	Context. nav.						x	x		xx				xx				x							x	
CP	Context. nav.						x		x		x			xx	xx											
EU	Wizards							x						xx		xx		x							x	
EU	Sitemaps						x	x						xx		xx		x								
EU	Indexes						x	x						xx		xx		x								
CP	Indexes								x					xx	xx				x				x			
Search Systems																										
EU	Search engine							x						xx	xx	xx		x			x			x		
EU	Search zones							x						xx				x			x				x	
EU	S. query input							x						xx		xx		x			x			x	x	
EU	S.results displ.							x						xx		xx		x			x			x	x	
Labeling Systems																										
EU	L. as headings						x	x		x				xx				x								
EU	L. within nav.						x	x						xx				x			x				x	
CP	L. as index t.						x		x		x			xx	x			x								

Note. Read: for each IA system deficiency reported by either end users (EU) or content providers (CP), IA process steps marked with “x” or “xx” can contribute to this deficiency. “xx”: main determinant; “x”: co-determinant.

Apart from these process deficiencies related to low quality of deliverables (i.e., ineffective processes), the previous literature reviews on IA systems and processes confirmed another major deficiency of IA processes: the *inefficiency* of IA processes, due to an inadequateness of the process description for, and insufficient scalability to, given project conditions (see 2.1.4.1 for details).

Table 4-9: IA Process Model, V0.2: exemplary detailed contribution of IA process deficiencies to the IA system deficiency “missing navigation choices”

PD #	Description of the process step deficiency
Process step 2.x: Perform Content Analysis	
P3	No alignment with EU research; content not analyzed with respect to user needs
Process step 2.x: Perform End User Research	
P2	User needs and requirements regarding navigation choices are not adequately identified
Process step 3.1.x: Align EU model & Content model	
P3	User needs regarding navigation choices are disregarded
P2	Inadequate alignment of content and EU needs (e.g., content sub-areas are not addressed in detail)
Process step 3.4.x: Design IA	
P3	EU research results regarding navigation choices not adequately translated into IA
P2	IA not fully specified (e.g., content sub-areas not defined in detail)
Process step 4.x: Perform Usability Tests	
P2	Missing navigation choices are not revealed in user testing due to inappropriate testing procedures, participants, test tasks, test environment
Process step 6: Implement / consult IA implementation	
P3	IA Design is disregarded and / or not accurately implemented
P2	Constraints (resources, technology) hinder adequate implementation of IA

4.3 Step 3: Key Target Criteria Definition

4.3.1 Outline and Objectives

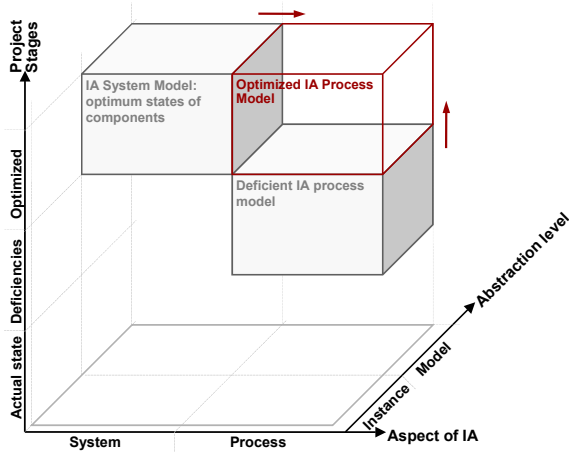


Figure 4-16: Visualization of step 3

Outline: From the IA System Model V0.3 on optimum values for IA system components, and the IA Process Model V0.3 on deficient IA processes, key target criteria for the to-be developed IA process model are derived.

Objectives: Defining tangible key target criteria for the IA Process Model, in order to be able to assess its success or failure.

4.3.2 Methods and Materials

Key target criteria for evaluating the IA Process Model were derived from the overall purpose and objectives for this thesis, as described in 3.2 and 3.3. Purpose and objectives were aligned with results from the IA System Model V0.3 and IA Process Model V0.3, and subsequently translated into quantifiable measures.

4.3.3 Results: Key Target Criteria for the IA Process Model

From the overall purpose of the thesis (see 3.2) and the IA System Model V0.3 on optimum values for IA system components, a first target for the to-be developed process *model* was defined as the (1) *effectiveness* of process *instances*: delivering IA system instances which improve user and business goal achievement. However, any process involves spending resources, which in turn affects business goal achievement. IA processes also frequently suffer from inefficiency, as outlined for the IA Process Model V0.3. Accordingly, a second target for the process model was defined as the (2) *efficiency* of process *instances*: minimizing resources expended in relation to the effectiveness of project instances. In turn, as stated in 3.3, to be effective and efficient, any process has to be tailored in focus and scope to individual project constraints. Hence, a third target for the process model was defined as (3) *scalability* of the process *model* to account for variable project conditions.

In sum, the overall target of the IA process *model* was defined as “ensuring (1) effective and (2) efficient IA process *instances* in (3) variable conditions”.

Overall target of the IA Process Model:

Ensuring (1) effective and (2) efficient IA process instances in (3) variable conditions.

This overall target was broken down into three key target criteria (TC) for the process model:

Key Target Criteria for the IA Process Model:**TC1: *Effectiveness* of IA process instances:**

TC1.1: usability of IA system instance $> 80\%$ ¹¹⁶ (improved user goal achievement)

TC1.2: business goal achievement $> 80\%$ (improved business goal achievement)

TC2: *Efficiency* of IA process instances:

TC2: Ratio (process instance effectiveness) / (resources spent [time, money, work-force]) $>$ reference value (to be defined for individual projects)

TC3: *Scalability* of the IA process model:

TC3: Random selection of a project to instantiate the IA process model and carry out the resulting IA process instance. From the project being successfully carried out (in terms of TC1.1 through TC2), it is concluded that the process model is sufficiently flexible to adjust to individual project constraints.

¹¹⁶ The value of 80% for key target criteria TC1.1 and TC1.2 were based on the 80/20 ratio introduced by the “Pareto Principle”, describing the notion that most (e.g., 80%) of the results (of a life, of a program, of a financial campaign) come from a minority (e.g., 20%) of effort (or people, or input). The 80/20 rule thus describes an optimum ratio of results and effort. As in many areas, in IA and similar design practices, it has been found reasonable to focus efforts on achieving these 80% of results rather than aiming for an (usually not achievable) 100% (Rosenfeld, 2002a).

4.4 Step 4: Process Flow Setup

4.4.1 Outline and Objectives

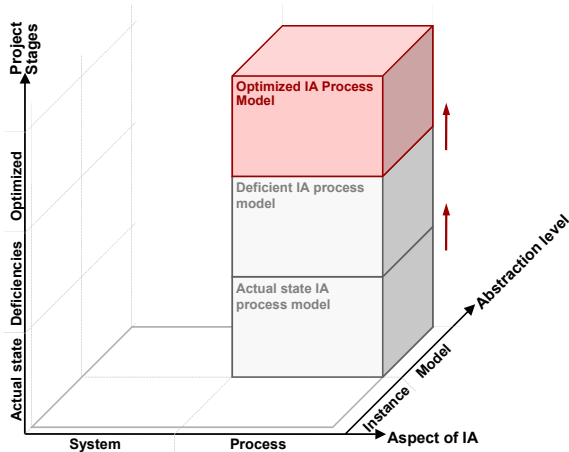


Figure 4-17: Visualization of step 4

Outline: Based on the IA Process Model V0.1 and V0.3, an optimized IA process model (the IA Process Model V0.4) is derived.

Objectives: Defining process phases, single process steps and the overall process flow of the optimized IA Process Model.

4.4.2 Methods and Materials

4.4.2.1 Basic Rationale for Setting up the IA Process Model V0.4

The development of the optimized IA process was based on the (1) IA Process Model V0.1 on actual state IA processes, and the (2) IA Process Model V0.3 on deficiencies of IA processes. For the former, this implied using the actual state of IA processes described in the model as a starting point for defining process phases, steps, roles, and inputs/ outputs. For the latter, the basic rationale included translating each process deficiency identified into an improvement of individual process steps or the overall process flow. To achieve this, the three types of process deficiencies defined in Chapter 4.2.4 were accounted for in step 4.1 (see below) as follows:

- PD1: *Previously missing process steps* were newly defined in step 4.1.1.
- PD2: *Insufficient focus and scope of process steps* were also re-defined in step 4.1.1.
- PD3: *Previously unaccounted-for dependencies between process steps* were adequately translated into an input-output relationship (steps 4.1.2 and 4.1.3) and subsequently transformed into an appropriate temporal sequence of and explicit links between process steps (step 4.1.4)

The definition of roles is extremely context-dependent, as described in Chapters 2.1.4 and 2.2. Roles vary broadly between companies, departments, and projects, and evolve over time. Thus, generic roles defined here were derived on a basis of most frequently applied and most approved roles in current IA practice.

4.4.2.2 Sub-Step 4.1: Post-It™ Sketches of Overall Process Flow

In this initial sub-step of the overall process setup, differently colored Post-It™ notes were used to represent (1) focus of process steps, (2) input needed and output delivered, and (3) responsible / involved roles. Post-It™ notes were fixed on a large, 5 x 8 ft. paper sheet to develop an initial process flow diagram. The basic procedure, then, involved five steps:

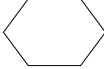


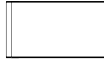






1. Defining process steps, including focus and scope
2. Defining input needed and output delivered by each process step
3. Defining dependencies between process steps according to respective in- and output.
4. Arranging steps according to dependencies, defining phases and links between steps
5. Defining responsible and involved roles for each process step

4.4.2.3 Sub-Step 4.2: Visio™ Documentation of Overall Process Flow

In the second sub-step, the Post-It™ sketch of process flow was transformed to digital representations using a method called ARIS (Architecture of Integrated Information Systems; Davis, Rob, 2001). ARIS is a well-approved concept for modeling business processes. It provides a framework and language for describing processes based on the notion of an “Event-Driven Process Chain”, which breaks down processes into events, functions, rules, and resources:

- Events: changes in the state of the world as a process proceeds
- Functions: activities or tasks carried out as part of a process
- Rules: directives that further model triggers before, or decisions after a function
- Resources: e.g., organizational units, persons, locations, systems, data, knowledge

Figure 4-18 shows the respective icons used in the modeling of the IA Process Model.

	Event*: trigger or result of a process step, general state change		Document (e.g., reports, manuals)
	Function*: process step		Position*: responsible or involved role in a process step
	Main flow of process step outputs		Method(s) applicable in a given process step
	Additional flow of process step outputs		Documented knowledge (e.g., research results)
	Coordination of parallel process steps performed simultaneously through exchange of intermediate results		Rule “AND”*: (1) before a function: all preceding events must occur to trigger the function; (2) after a function: process flow splits into two or more parallel paths

**Figure 4-18: Icons used in modeling the IA Process Model V0.4
(based on ARIS (marked with an asterisk) and standard task flow language)**

Although there are dedicated ARIS software packages available, the modeling here was performed using Microsoft Visio™. The basic procedure involved translating every Post-It™ note from the previous step into a digital icon, and subsequently arranging and connecting icons in Visio™, according to the sketches created in step 4.2.

4.4.2.4 Sub-Step 4.3: PowerPoint™ Documentation of Process Phases

In the final step of V0.1, PowerPoint™ slides were generated providing a written outline of the respective Visio™ diagrams, in order to allow for more detailed process documentation.

Figure 4-19 shows the template used with respective explanations.

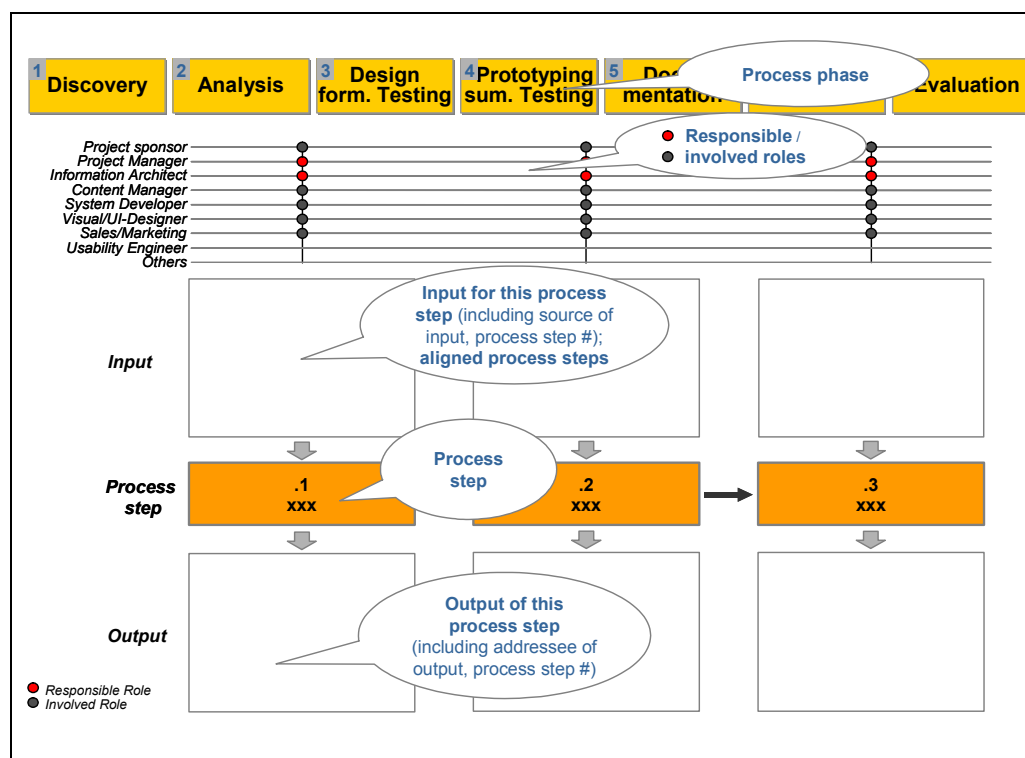


Figure 4-19: Template for detailed documentation of process phases for V.01 of the Optimized IA Process Model

4.4.3 Results: IA Process Model V0.4: Optimized Process Flow

4.4.3.1 Naming the IA Process Model: “LUCIA”

Labeling the process model required a term that adequately represented the model and its core characteristics. After several iterations, the acronym “LUCIA” was chosen: “Leveraging User-Centered Information Architecture”. In addition to traditional (end) user-centered design practices, this short form emphasizes one of the core unique selling points of the model: the explicit addressing and integration of content provider needs and capabilities as a second main

user group of IA systems, next to end users, throughout the process. To enhance comprehensibility and provide consistency across this thesis, for the preliminary versions of the process model, the term “IA Process Model” is used; only the final version 1.0 will be referred to as “LUCIA”.

4.4.3.2 Documentation of Roles Defined for the Process Model

Table 4-10 shows the roles defined for the IA Process Model V0.4. Each role is briefly characterized with a generic description of activities or responsibilities assigned to this role.

Table 4-10: IA Process Model, V0.4: roles within the process

Acronym	Role Title	Description / Responsibilities
PS	Project Sponsor	Client (contracting entity)
PM	Project Manager	Responsible for the coordination of sub-projects
IA	Information Architect	Design of the website's IA system
SD	System Developer	Technical implementation of site and CM system
VD	Visual/UI-Designer	Visual design of the site
SM	Sales / Marketing	Brand development / brand management
CM	Content Manager	Content Management Process and Content Management System
UE	Usability Engineer	Analysis of End User context of use & requirements; usability evaluation
CP	Content Provider	Sub-roles: authors, editors, metators
EU	End User	Individual accessing the website

4.4.3.3 Documentation of the Overall Process Flow

Figure 4-20 demonstrates the initial process flow documentation for the IA Process Model V0.4 using differently colored Post-It™ notes. Process steps (yellow Post-It™ notes) are arranged horizontally, on a time scale running from left to right, with inputs and outputs left and right of each process step, respectively (white Post-It™ notes). Roles are indicated with blue notes on top of each process step.

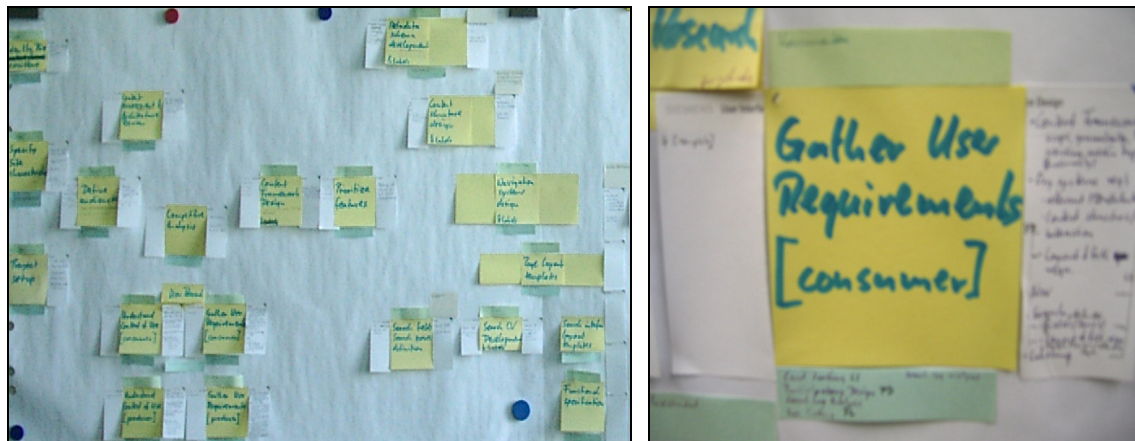


Figure 4-20: Initial, paper-based process flow documentation of the IA Process Model V0.4: overview (left) and exemplary detailed process step (right)

The documentation of the overall process flow in Visio™ is presented in Figure 4-21.

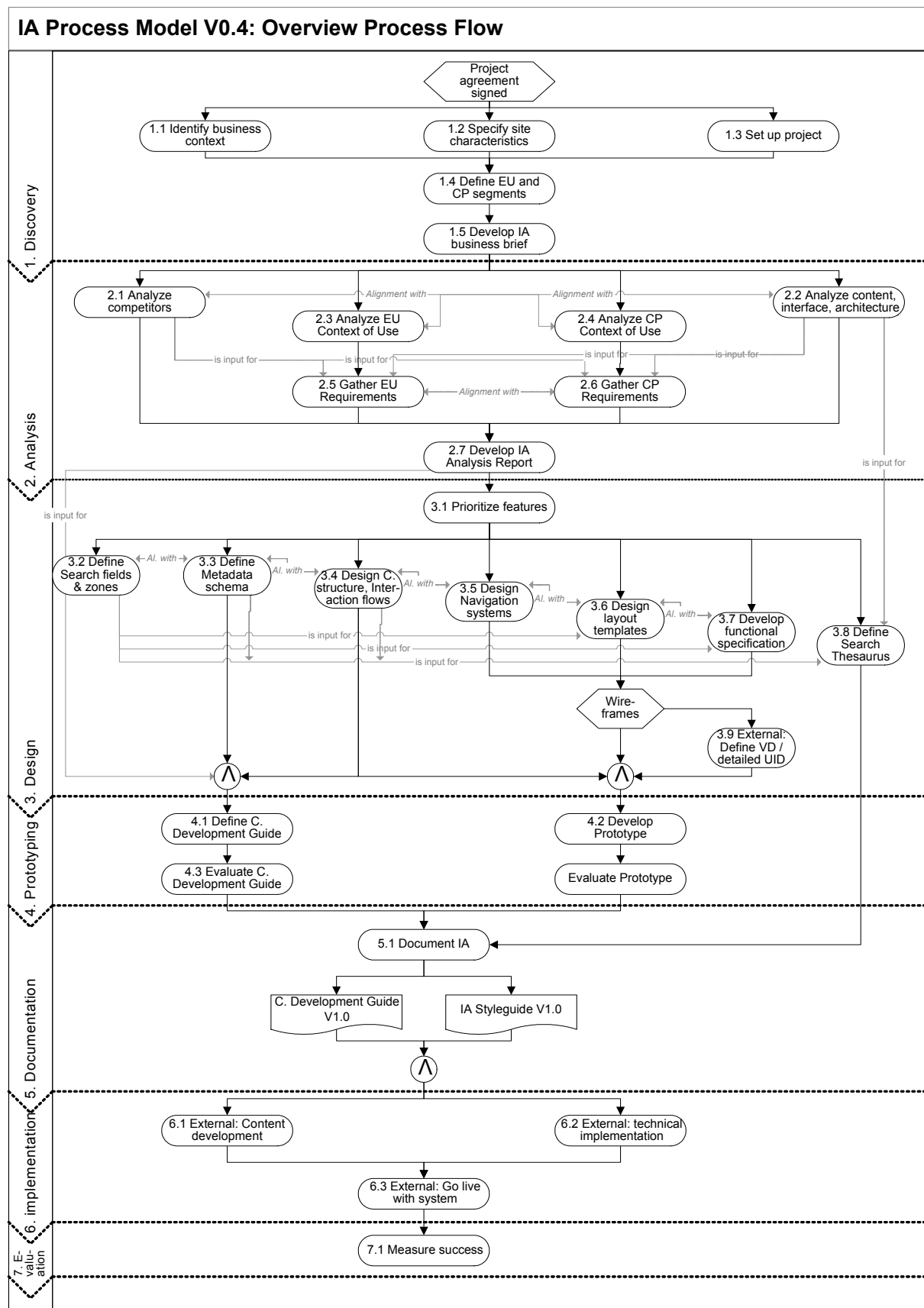


Figure 4-21: IA Process Model, V0.4: overview process flow

In this diagram, the timeline runs vertically from top down; thus, an identical vertical level of process steps indicates a parallel performance of these process steps. A partial vertical overlap between two process steps, therefore, implies that the preceding process step (the vertically superior) should not be finalized before the following (the vertically inferior) has been at least started and generated preliminary results, in order to be able to align these process steps through mutual exchange of results.

While Figure 4-21 presents an overview on the process flow, the Visio™ documentation also included a closer look at every process step, detailing applicable methods, responsible and involved roles, and results of each, which resulted in a very large diagram (about 3x5 ft.). Due to its preliminary character and lack of space, it is not presented here in total. Rather, Figure 4-22 shows an exemplary detailed documentation of a process step. At this stage, methods were only assigned to overall phases; therefore, no valid allocation of methods for single steps was possible yet (as seen in the empty “methods”-box in Figure 4-22).

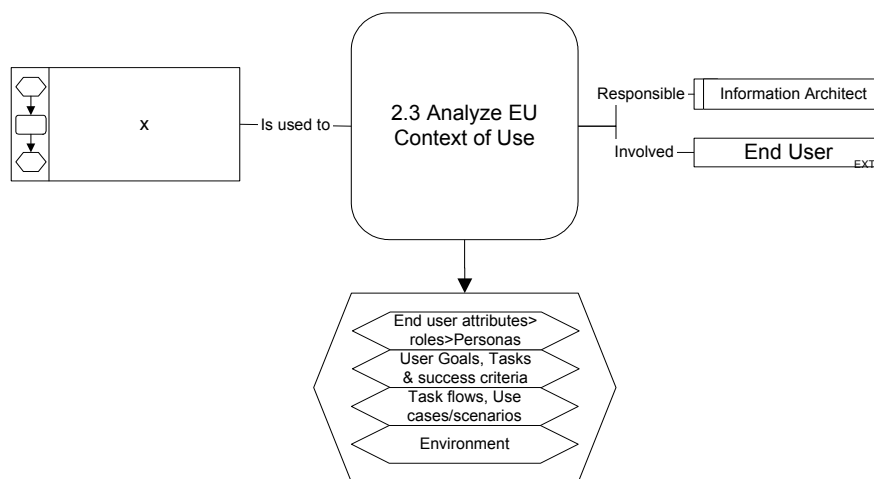


Figure 4-22: IA Process Model, V0.4: exemplary detailed process step documentation

4.4.3.4 Documentation of Individual Process Phases

Figure 4-23 presents an overview on process phases, including the milestones achieved in each phase, while Figure 4-24 shows an example of a detailed process phase description, specifying individual inputs/outputs, responsible/involved roles, and mutual alignments for process steps 2.4, 2.5, and 2.6. For the complete sequence of slides documenting detailed process phases, see Appendix B-3.1.

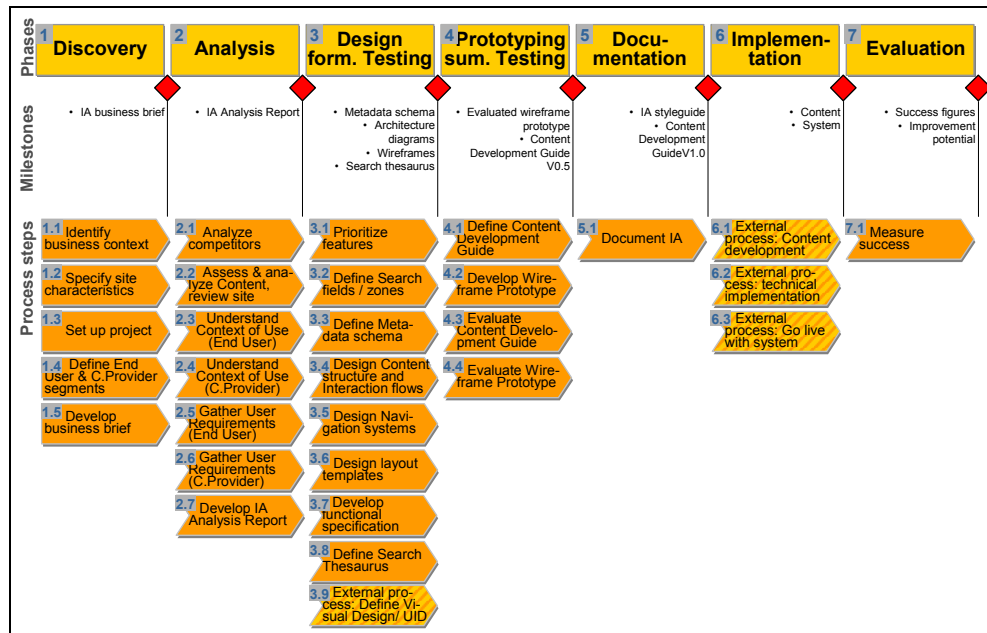


Figure 4-23: IA Process Model, V0.4: overview process phases

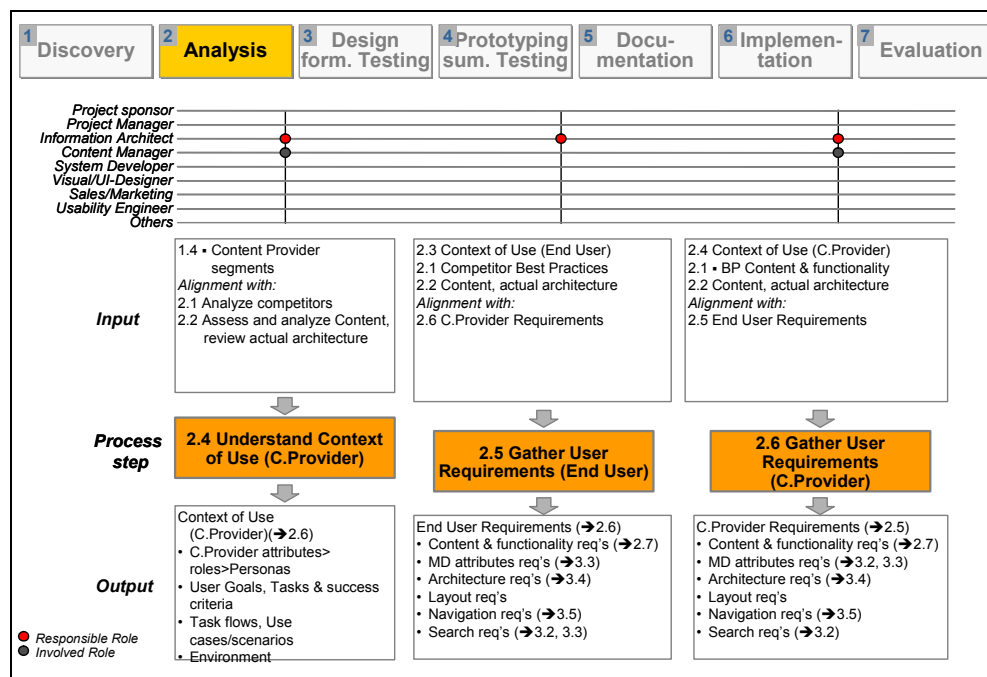


Figure 4-24: IA Process Model, V0.4: exemplary detailed process phase documentation

4.5 Step 5: IA Methods Catalog Setup

4.5.1 Outline and Objectives

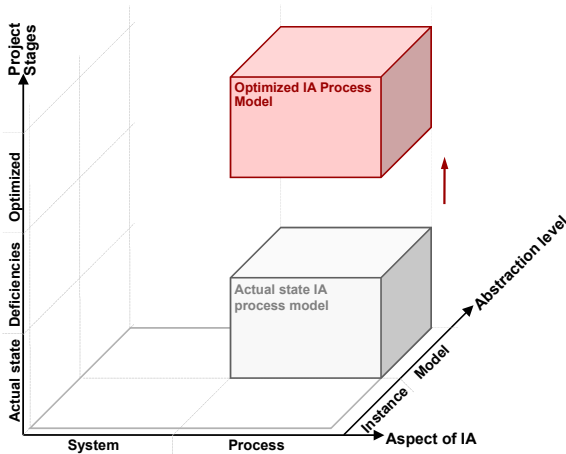


Figure 4-25: Visualization of step 5

Outline: Based on the list of current IA methods defined in the IA Process Model V0.2, a comprehensive description of methods is devised (the IA Process Model V0.5), including applicability in individual process phases of the IA Process Model, and additional selection criteria.

Objectives: Allocating adequate IA methods to respective process phases of the IA Process Model V0.4, and defining adequate selection criteria, in order to increase scalability of the process model by providing a range of applicable methods for each process phase to choose from.

4.5.2 Methods and Materials

The analysis was based on the list of current methods as developed in step 2.2 for the IA Process Model V0.2 (see Chapter 4.2.3). From the description of each method's focus, benefits, and shortcomings, and based on the definition of Optimum IA Process phases and steps (Chapter 4.4), process *phases* were identified each method is applicable to. A method was rated applicable for a specific process phase if at least one resource confirmed this. Additional selection criteria (SC) for choosing a particular IA method to conduct a specific IA process step were defined based on the results of previous literature reviews on IA processes and methods (see 4.2.2 and 4.2.3), and through informal expert discussions. Thus, overall, four major selection criteria were defined:¹¹⁷

Methods Selection Criteria (SC):

SC1: The *process phases (steps)* each method is applicable to

SC2: The *amount of resources* needed to conduct the method (in terms of work force)

SC3: Whether or not direct *user participation* is necessary to conduct the method

SC4: The *level of UCD expertise* necessary for the researcher to be able to conduct it properly

Selection criterion SC1 is refined in subsequent steps to identify individual process *steps* methods are applicable to. For selection criteria SC2 and SC4, a five-level ordinal scale was defined with 1 and 5 denoting low and high amount of resources needed / level of expertise necessary, respectively. SC2 involved a binary yes/no decision. Initial values for SC2 and

¹¹⁷ For a similar description of UCD method selection criteria, see Bevan (1999).

SC4 were averaged across ratings found in the literature; for SC3, one positive rating found in the literature (end user participation *is* necessary) resulted in a positive value (yes).

4.5.3 Results: IA Process Model V0.5: Methods Catalog

Table 4-11 shows the resulting matrix, listing methods in rows, and process phases and selection criteria in columns. Process phase 5 (Documentation) was excluded due to the phase's focus on merely revising deliverables, which does not allow for extensive use of specific methods. Each "x" at the intersection of a method and a process phase indicates applicability of this method in the respective process phase. However, as the available literature did not account for all data required, these results remained incomplete. Also, due to the often arbitrary, hardly comparable (across resources), and also for SC2 and SC4 only binary nature (either high or low) of ratings found in the literature, the results did not allow for a valid and graded specification of values for the selection criteria; thus, additional expert ratings were performed subsequently (see 4.6) to revise the methods catalog.

Table 4-11: IA Process Model, V0.5: Methods Catalog

Method	SC1: IA Process Phase						SC2 - SC4		
Selection Criteria: SC1: Applicability in process phase # SC2: Resources needed (1-5) SC3: End user participation necessary (y/n) SC4: Necessary UCD experience (1-5)	1 Discovery	2 Analysis	3 Design & f. T.	4 Prototyping & s. T.	6 Implementation	7 Evaluation	SC2 (1-5)	SC3 (y/n)	SC4 (1-5)
Affinity Diagramming	x	x	x						1
Best Practice/ Competitive Analysis		x							
Card Sorting		x					1	y	1
Consolidated Assessment		x						y	
Content Inventory		x					5		
Contextual Inquiry		x					5	y	
Critical Incident Technique		x				x		y	
Diary keeping		x				x		y	
End User Feedback Analysis		x				x			
Field study		x						y	
Focus Group		x	x					n	
Free Listing	x	x						n	
Functionality matrix		x							
Group discussion		x	x					y	
Interface Design Patterns			x	x				n	
Interview		x		x		x	3		3
Log File Analysis		x				x			
Parallel design			x	x			1		1
Participatory Design			x	x					
Prioritization exercise			x						
Prototyping			x	x					
Paper Prototyping			x	x			1		1
Video Prototyping			x	x			1		1

Computer-based (Rapid) Pt			x	x			3		
Wireframe Prototyping			x	x					
Questionnaire		x		x		x	3	y	3
Scenarios, scenario building exercise		x							
Storyboarding			x	x			1		1
Survey		x		x		x	3	y	3
Task Analysis		x					3	y	
Task Allocation chart			x	x					
Usability Context Analysis		x						n	
(Usability) Inspection		x		x		x		n	
Heuristic evaluation		x		x		x	1	n	3
Guideline reviews		x		x		x		n	
Standards inspections		x		x		x		n	
Formal Usability inspection		x		x		x		n	
Consistency inspections		x		x		x		n	
Human performance models (GOMS)		x						n	
(Usability) Test		x	x	x		x		y	
Performance measurement		x	x	x		x		y	
Co-operative evaluation		x	x	x		x	3	y	1
Wizard of Oz technique			x	x		x		y	
Perceived IA Test		x	x	x		x	1	y	
Structure evaluation		x	x	x		x	1	y	
Card-based classification evaluation		x	x	x		x		y	
User Profile analysis/ Persona dev.		x							
Walkthrough			x	x		x			
Pluralistic Walkthrough			x	x		x		y	
Cognitive Walkthrough			x	x		x		n	
Usability Walkthrough			x	x		x		y	
Workshop									
Brainstorming	x	x	x						
Stakeholder meeting	x								

4.6 Step 6: Expert Evaluation Focus Groups

4.6.1 Outline and Objectives

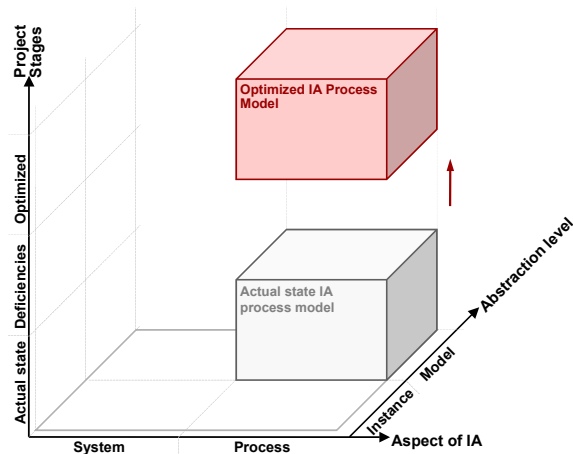


Figure 4-26: Visualization of step 6

Outline: Focus groups were conducted with IA and UE experts of Siemens AG (N=7) in Munich/ Germany and Princeton/ US. The IA Process Model V0.5 was presented to participants and critically reviewed by them. IA methods were rated by participants according to the previously defined selection criteria. The validation project was introduced, and participants gave estimates on base values of the project (e.g., person-days needed)

Objectives:

(1) Evaluating the IA Process Model V0.4:

- Validate and revise overall process flow, focus and scope of single process steps by aligning it with current best IA practice.
- Collect ratings of IA methods with regard to the previously defined selection criteria

(2) Assembling base values as benchmarks for the subsequent validation project

4.6.2 Methods and Materials

Two expert focus groups (FG) were conducted. While the former (referred to as FG1 subsequently) took place in Munich, Germany, and involved a four-hour group session with UE experts from Siemens's User Interface Design Center (CT IC 7; N=4), the latter was carried out in Princeton, US, with IA and UE experts of Siemens' Corporate Research (SCR; N=3), and lasted eight hours. All participants had a minimum of 2 years of experience in their field, confirming their expert status (see Table 4-12).

Table 4-12: Participants of the expert evaluation focus groups

#	Job title	Field of experience	# ys. experience	Company/ Department	Location
1	Consultant	UE	9	Siemens AG / CT IC 7	Munich / Germany
2	Consultant	UE; UID Concept & Design	2	Siemens AG / CT IC 7	Munich / Germany
3	Consultant	UCD; UE; IA;	3	Siemens AG / CT IC 7	Munich / Germany
4	Consultant	UE; Interaction Design	3	Siemens AG / CT IC 7	Munich / Germany
5	Information Architect	IA; UID; Business Analysis	15	Siemens AG / SCR	Princeton / US
6	Information Architect	IA	8	Siemens AG / SCR	Princeton / US
7	Consultant	UE	5	Siemens AG / SCR	Princeton / US

For each session, the agenda was split into four major parts:

1. Introductory presentation
2. Presentation and revision of the IA Process Model V0.5

3. Introduction to the IA Methods Catalog and participants rating IA methods
4. Presentation of the validation project and participants estimating base values

(1) *Introductory presentation*: Participants were briefly introduced to the session's focus and objectives with a presentation on the concepts of IA (as described in Chapter 2.1), the rationale and basics of the process model (Ch. 3, 4.1, 4.2), and target criteria for the process model (Ch. 4.3.3), in order to establish a common starting point and language.

(2) *Presentation and revision of the IA Process Model V0.5*: To facilitate discussion, two large sheets of paper (1x2 ft.) were fixed to a wall for everyone to read. One included definitions for basic terms (see Table 4-13) and empty rows to add any term causing confusion during the session, while the second defined roles as described in Chapter 4.4.3.2.

Table 4-13: Definitions for basic terms used in the expert evaluation focus groups

Term	Definition
Process model	Generic description of process flow, -phases and -steps; collection of methods for each step
Process step	Includes solving a circumscribed problem (E.g. „Context of Use?“); can be implemented using various methods
Process phase	Group of single process steps, whose performance results in an overall outcome (milestone)
Process flow	Sequence of and dependencies between single process steps: flow of in- & output
Method	Concrete activities carried out within a process step to solve a circumscribed problem (e.g. problem: „what is the context of use?“; method: performing end user interviews)

The overall process flow of the IA Process Model V0.5, as described in 4.4.2.3, was then gradually developed by the moderator using colored index cards (6x9 inches): each process step was represented by a blue, rectangle index card, while white ellipsoid cards denoted the results of a process step or its triggers. Starting with the trigger for the first process steps, index cards were stepwise fixed to large erasable boards (each 3 x 4 ft.) according to the overall process flow as defined in Figure 4-21 (Page 149), connecting them by lines drawn with erasable markers in different colors: black lines showed the basic process flow (flow of input and output), red lines indicated the alignment of individual process steps, and vertical green lines denoted the beginning of a new process phase. For each process step, the presenter explained rationale and objectives, and answered any questions. After completing a process phase, participants were asked for their opinions, practical experiences, and suggestions for revising the process flow. Through discussion, re-definition and re-arrangement of process steps, and re-drawing of connecting lines, a group consensus for the flow of process steps in each phase was achieved, and digital pictures were taken of the final process flow diagrams. Any doubts, questions, or recommendations that came up during the discussion of the process model were recorded.

(3) *Introduction to the IA Methods Catalog and participants rating IA methods*: Participants were introduced to the concept of a methods catalog with selection criteria for each method. They were given two sheets of paper, one with an empty matrix plotting methods against selection criteria (identical to Table 4-11, Page 153, but without data values), the second listing descriptions of methods (as given in Table 4-7, Page 135). Participants were then asked to each individually rate each method, according to the four selection criteria defined in 4.5.2. Thus, they marked adequate process steps with an “x” (SC1), rated resources and expertise necessary from 1 to 5 (SC2 and SC4), and decided on the necessity of end user participation with “y” or “n” (SC4). No time constraints were imposed, and participants were free to leave out any method with which they were not familiar. Any questions regarding single methods or the rating procedure were answered by the moderator throughout the rating exercise, but no discussion of ratings was allowed. After completion, rating sheets were collected for later analysis. Additional ratings were obtained subsequently from other experts of the Siemens Center for User Interface Design (N=3; see Table 4-14). These were individually briefed and asked to give their ratings in the same manner as in the focus groups.

Table 4-14: Additional experts who participated in the rating of IA methods

#	Job title	Field of experience	# ys. experience	Company/ Department	Location
8	Consultant	UE, SQL	7	Siemens AG / CT IC 7	Munich / Germany
9	Consultant	UE, IaD, Requirements Engineering	7	Siemens AG / CT IC 7	Munich / Germany
10	Consultant	UE; IA; IaD; UID;	5	Siemens AG / CT IC 7	Munich / Germany

For analysis of ratings, a threefold approach was followed:

- SC1: a given method was considered applicable in a particular process phase if at least two experts said so (by marking the intersection with an “x”).
- SC2 and SC4: for the numerical ratings of each resources and expertise necessary, the median value was computed across participants for each method.
- SC3: any method was assumed to require end user participation if at least one expert indicated this by marking the respective cell with a “y”. Not a single “y” and at least one “n” resulted in the method to be recorded as not requiring end user participation. Else, the cell remained blank.

(4) *Presentation of the validation project and participants estimating base values*: Basic characteristics of the validation project described in Chapter 4.7 were presented to the participants. Characteristics included (1) facts about the to-be redesigned application (scope of content and functionality, targeted end user groups, content management process details), and (2) project

data (focus and scope, planned process steps and methods, objectives/ deliverables, constraints of the project, and resources). Participants were then asked to estimate, for workforce of both IA expert and working students, person-days needed to perform each of the project phases and overall project duration in person-days. Participants individually noted down their estimates, and notes were collected from each participant after completion.

4.6.3 Results: IA Process Model V0.6: Revised Process Flow & Methods Catalog

4.6.3.1 IA Process Model V0.6: Revised Process Flow

Figure 4-27 shows pictures taken during the workshops for documentation of results. From these images and additional documentation, the basic process flow was revised in Visio™ (see Figure 4-28). As in this stage, documentation was only for internal use, and due to time constraints (the kick-off for the validation project followed immediately), no detailed documentation of process phases and steps was performed for this IA Process Model V0.6.

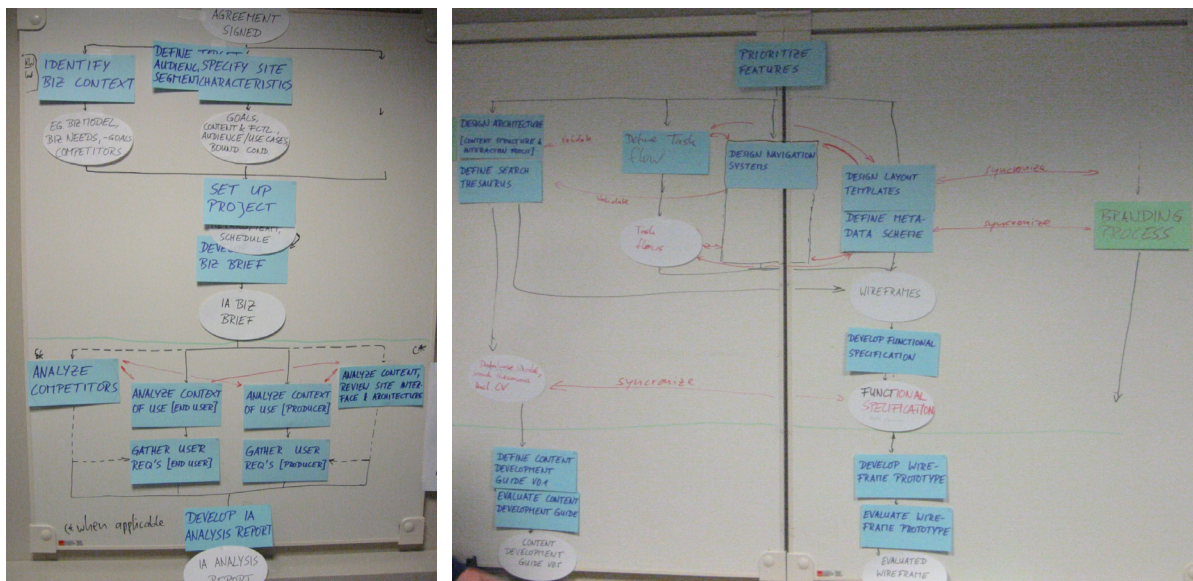


Figure 4-27: Pictures taken in the expert evaluation focus groups to document results (here: revised IA process flow for phases 1 through 4, taken from FG2)

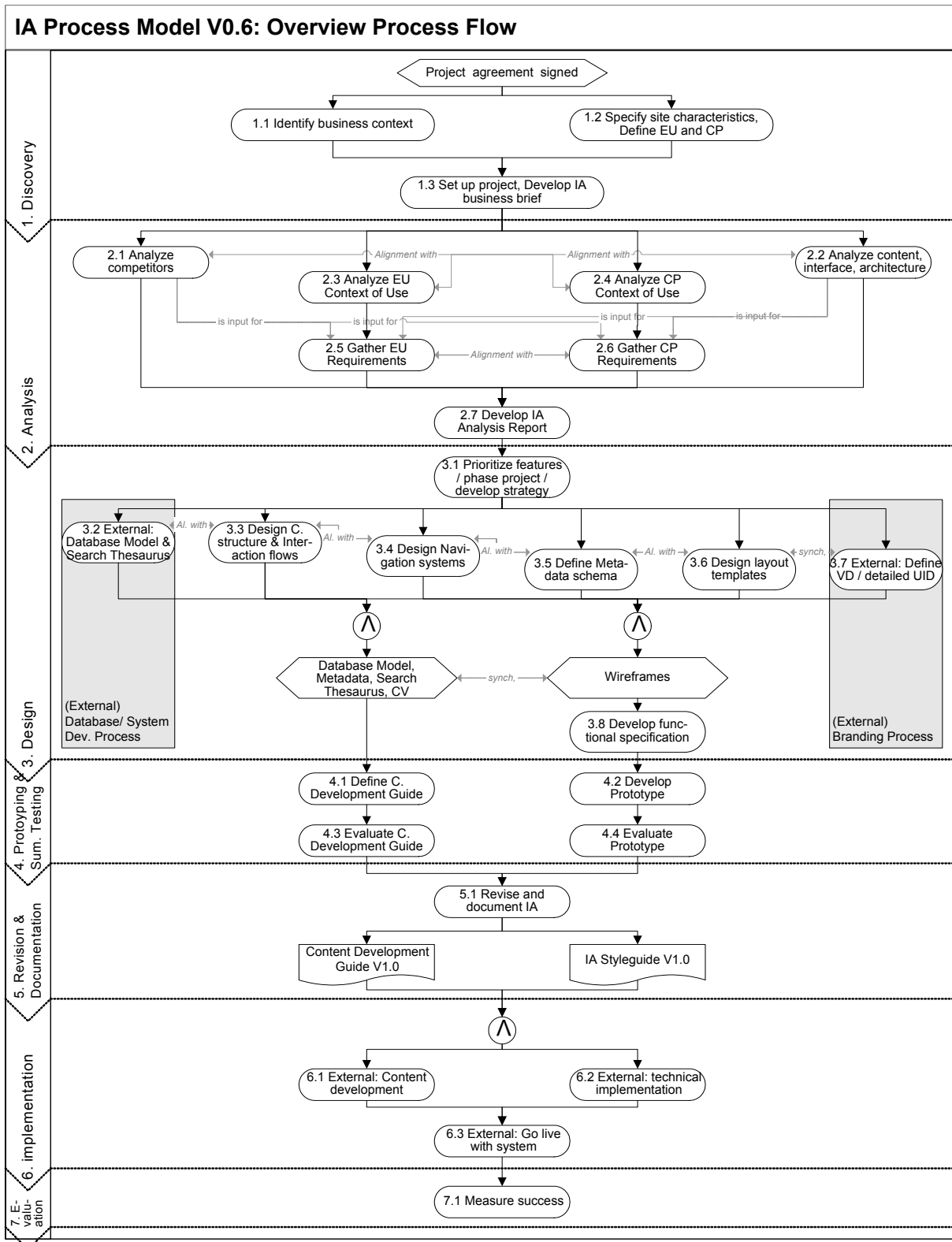


Figure 4-28: IA Process Model V0.6: overview process flow

4.6.3.2 IA Process Model V0.6: Revised Methods Catalog

Table 4-15 presents the revised IA Methods Catalog, based on the ratings of ten Siemens UE / IA experts.¹¹⁸ The expert ratings for each method were pooled with the data of the Methods Catalog of V0.5 according to the following explicit rationale:¹¹⁹

- SC1: a given method was rated to be applicable in a particular phase if (1) at least one resource in V0.5 OR (2) at least two experts in the evaluation focus groups confirmed this.
- SC2 and SC4: as described in Chapter 4.5.3, data from the literature review for V0.5 particularly for these numerical ratings was prone to be too arbitrary, coarse, and incomplete. These results from the literature review were thus not accounted for in V0.6, but expert ratings were translated one-to-one to the IA Methods Catalog of V0.6.
- SC3: a given method was rated as requiring end user participation if at least (1) one resource in V0.5 OR (2) one expert confirmed this. Else, if at least (1) one resource in V0.5 OR (2) one expert judged the method not to require end user participation, this resulted in the method being rated accordingly. Otherwise, no rating was given.

The two methods “Focus group” and “Group discussion” were pooled due to their large overlap in methodological focus, scope, and procedure. Expert’s ratings for SC2 and SC4 of the pooled method “Focus group / Group discussion” were computed across raw data of both original methods, and the rationale for SC1 and SC3 was extended across both.

Table 4-15: IA Process Model V0.6: Revised Methods Catalog

Method	SC1: IA Process Phase						SC2 - SC4			# of expert ratings
	1 Discovery	2 Analysis	3 Design & f. T.	4 Prototyping & s. T.	6 Implementation	7 Evaluation	SC2 (1-5)	SC3 (y/n)	SC4 (1-5)	
Selection Criteria: SC1: Applicability in process phase # SC2: Resources needed (1-5) SC3: End user participation necessary (y/n) SC4: Necessary UCD experience (1-5)										
Affinity Diagramming	x	x	x				1,5	y	1,5	4
Best Practice/ Competitive Analysis	x	x	x			x	3	n	3	8
Card Sorting		x	x			x	2	y	3	7
Consolidated Assessment		x	x				3,5	y	4	2
Content Inventory	x	x					3	y	4	3
Contextual Inquiry	x	x	x				4	y	5	7
Critical Incident Technique		x	x			x	2	y	3	6
Diary keeping	x	x					3	y	2	5

¹¹⁸ For distinct (i.e., not pooled with V0.1 data) results of expert ratings regarding the IA Methods Catalog, see Appendix B-4.

¹¹⁹ Using Boolean operators

End User Feedback Analysis		x				x	3	y	3	7
Field study	x	x				x	5	y	4	8
Focus Group / Group Discussion	x	x	x	x		x	3,5	y	4	9/7
Free Listing		x					1	y	1,5	5
Functionality matrix		x			x		3	y	4	3
Interface Design Patterns		x	x	x	x		4	y	4,5	5
Interview	x	x	x	x		x	2	y	4	9
Log File Analysis		x				x	3	n	3	2
Parallel design			x				4,5	y	4,5	4
Participatory Design		x	x	x			4	y	4	6
Prioritization exercise		x					3	y	3	3
Prototyping			x	x			3	n	3	1
Paper Prototyping			x	x			2	y	3	8
Video Prototyping			x	x			3	n	2	3
Computer-based (Rapid) Pt			x	x	x	x	4	y	4	6
Wireframe Prototyping			x	x			3	n	3,5	6
Questionnaire	x	x	x	x		x	3	y	3,5	9
Scenarios, scenario building exercise		x	x	x			3	y	4	7
Storyboarding			x	x		x	2,5	y	3	6
Survey		x	x			x	3	y	3,5	6
Task Analysis		x	x				4	y	4	9
Task Allocation chart		x					4	n	4	3
Usability Context Analysis		x					3,5	y	4	6
(Usability) Inspection		x	x	x		x	2	y	4	7
Heuristic evaluation		x	x	x		x	2	n	4	7
Guideline reviews		x	x	x		x	2	n	4	4
Standards inspections		x	x	x		x	2	n	4	4
Formal Usability inspection		x	x	x		x	3,5	y	4,5	4
Consistency inspections		x	x	x		x	2	n	3	5
Human performance models (GOMS)		x		x		x	5	n	5	3
(Usability) Test		x	x	x		x	4	y	4	6
Performance measurement		x		x		x	4	y	3	7
Co-operative evaluation		x	x	x		x	4	y	4	5
Wizard of Oz technique			x	x		x	4	y	3	5
Perceived IA Test			x			x	3	y	4	3
Structure evaluation			x				3	y	3	4
Card-based classification evaluation			x				3	y	2	3
User Profile analysis/ Persona dev.	x	x					3	y	4	5
Walkthrough		x	x	x		x	2	y	4	4
Pluralistic Walkthrough			x	x		x	3	y	4	5
Cognitive Walkthrough		x	x	x		x	2	y	4	7
Usability Walkthrough			x	x		x	3	y	4	5
Workshop	x	x	x			x	3	y	4	5
Brainstorming	x	x	x	x		x	2,5	y	3	6
Stakeholder meeting	x	x					2	y	3	3

4.6.3.3 Validation Project Base Values

Due to time constraints during FG2, data for the validation project base values could only be collected in FG1, resulting in four participants providing estimates. Table 4-16 shows the results for expected sum of IA expert- and working student person-days, together with additional comments.

Table 4-16: Estimates for expected sum of person-days for the validation project

Part. #	Person-days needed per phase						Sum	Additional comments
	Ori- enta- tion	Analy- sis	Rede- sign	Proto- typing	Evalu- ation	Docu- menta- tion		
1		26	40	30	30	40	166	“?” for documentation
2	4	36	20	10-20	10	30	110- 120	“>30” for documentation, indicating this to be a minimum value
3		20	30	10	20	20	100	“total of 6 person-months”, indicating an overall sum of 120 person-days
4		30	40 (pooled)		20	30	120	“very tightly calculated”
Min. Av^a	4	28	27,5	17,5	20	30	124	
Max. Av^b	4	28	27,5	20	20	30	126,5	

Note. Estimates as given by FG1 participants; comments translated from German by the author.

^a Counting minimum value for participant #2’s rating of prototyping activities, and 10 person-days for each of participant #4’s redesign and prototyping ratings, derived from the pooled rating (20).

^b Counting maximum value for participant #2’s rating of prototyping activities, and 10 person-days for each of participant #4’s redesign and prototyping ratings, derived from the pooled rating (20).

For the planned scope, available resources, and level of effectiveness of the validation project, the results show an average estimated project duration of 124 to 126,5 expert person-days. Given the additional comments raised by participants 2 through 4, this figure is rather a conservative estimate describing the minimum amount of time needed. However, in order to set an ambitious target criterion for the IA Process Model, the minimum score across all participants of 120 person-days was defined as the reference value for validation project duration. Thus, the efficiency reference value of TC2 can be calculated as:

Reference value for Target Criterion TC2:

$$\text{Efficiency reference value} = \frac{(\text{Full effectiveness as defined in TC1.1 and TC1.2})}{120 \text{ person-days}} = \frac{1}{120}$$

4.7 Step 7: Validation Project

4.7.1 Outline and Objectives

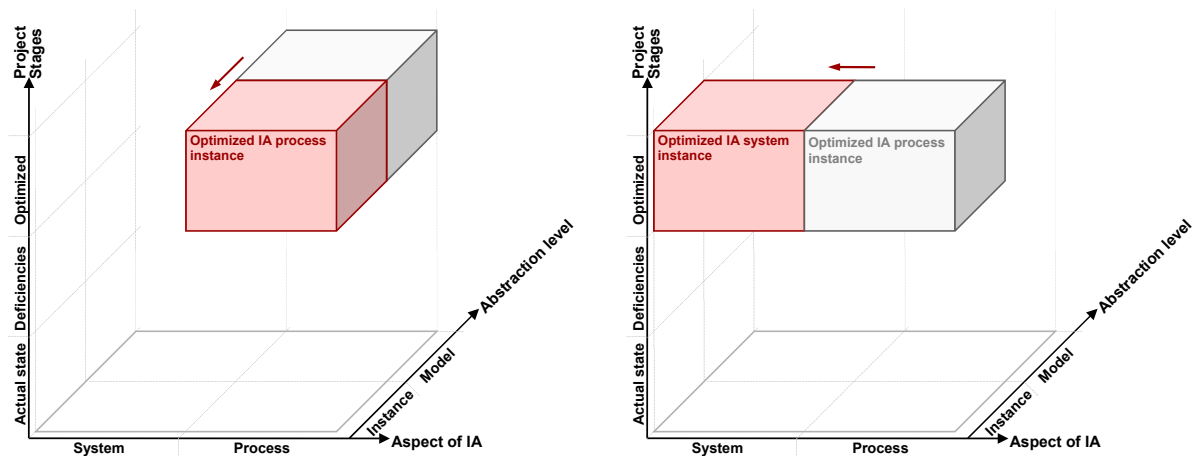


Figure 4-29: Visualization of step 7

Outline: From the IA Process Model V0.6, an optimum IA process instance was derived to be applied to a real-life IA project (left diagram). The project thus performed involved an overall IA redesign of a Siemens E-commerce website, resulting in an optimum IA system instance (right diagram).

Objectives: Evaluating the IA Process Model V0.6 against previously defined target criteria (Chapter 4.3) by applying it in a realistic setting.

4.7.2 Basics of the Validation Project

4.7.2.1 Project Acquisition

According to target criterion TC3 (scalability of the process model; see 4.3.3), acquisition of an adequate project was performed on a random basis. Thus, no preconditions were posed on:

- *Client:* organizational status (Siemens-internal or external) or geographic location
- *Application:* e.g., focus and size, target end user groups, scope of content and functionality
- *Project conditions:* e.g., project focus, scope, and methods

To ensure that the overall objectives for this second evaluative step 7 within the overall development of the IA Process Model are achieved, however, a few conditions were required:

1. Client: is willing to cooperate on and engage in a previously not tested process flow
2. Application:
 - website with a reasonable amount of content (minimum: 500 individual pages)
 - content is stored in a relational database
 - delivered by an underlying Content Management Process
3. Project conditions:

- project can be performed within the overall schedule for the PhD
- project is performed according to the IA Process Model V0.6
- allows the author to perform project with available resources or observe project execution by another IA/UE expert from the Siemens User Interface Design Center

To allow these conditions to be met, a special project billing agreement was set up. Thus, the workforce of the author as project manager, as well as of working students supporting the project, was paid for by CT IC 7, and hence free of charge for the client. Additional workforce of CT IC 7's regular employees (designers, usability experts – as needed), as well as all travel expenses and other material, were regularly charged to the client's account. Since no adequate projects were available at the time, active acquisition started with phone calls and presentations at several Siemens AG and Infineon Technologies AG departments.¹²⁰ The first project, which met the criteria as defined above, was chosen to be performed.

4.7.2.2 Project summary

Client and Application Characteristics

The client of the chosen project is a Siemens department offering professional development seminars to Siemens-internal and external customers, published via the web, CD-ROMs, and print catalogs. The client's website, called "Online Seminar Program" (referred to as "OSP" in the following), is accessible by Siemens employees as well as by the public. It contains about 1.000 descriptions of different seminar modules, and 95 descriptions of training sites, stored in an overall SAP R/3 information management system. End users are able to:

- browse a topical catalog of seminar modules
- use a search functionality (search for title, training site, or date of a seminar module)
- book any seminar module online (which was also possible via phone)
- set up a personal account listing seminar reservations, cancellations, and participations

The underlying Content Management Process involved five distinct organizational units. More than 50 authors, editors, and content managers worked on content in a distributed, decentralized publishing environment. Figure 4-30 shows the OSP's initial homepage.

¹²⁰ Branches included telecommunication, semiconductor industry, learning/education, and corporate research departments.

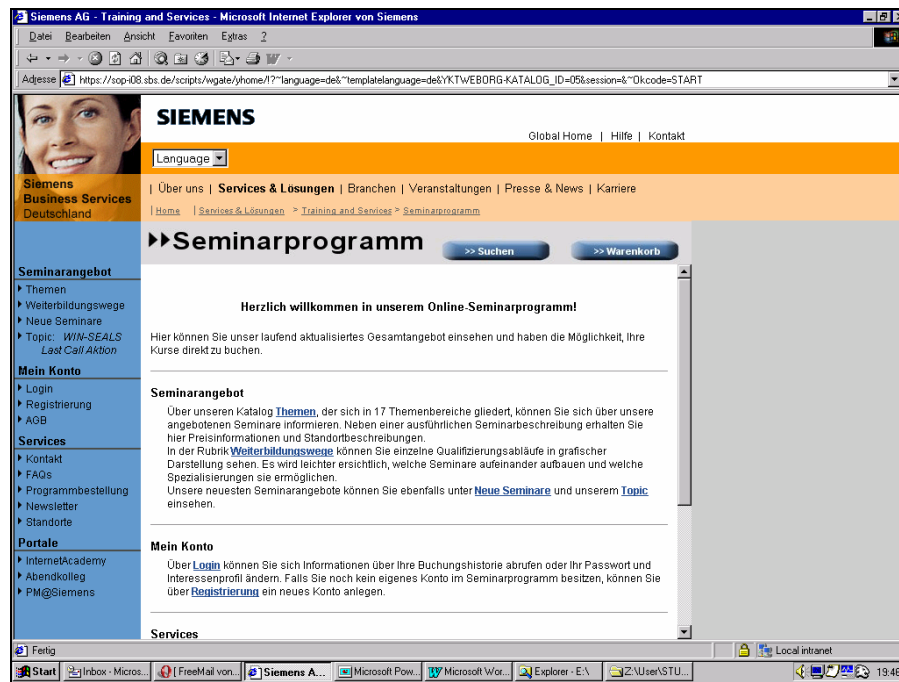


Figure 4-30: Homepage of the OSP (initial state)

Project Focus and Scope

Initial interviews with stakeholders for the OSP revealed various IA-related deficiencies, including inconsistent and suboptimal content, end user navigation / search problems, and failed online bookings (as apparent from numerous help desk calls). Thus, the project focused on redesigning the OSP's IA system according to the IA Process Model V0.6. Therefore, the project involved an initial discovery, followed by an analysis of OSP, competitor websites, and end user and content provider requirements. Based on the results of the analysis phase, the OSP IA system was redesigned, which included the definition and design of formal and semantic content requirements, metadata schemata, content structure and interaction flows, navigation and search systems, and layout and functionality of content- and search/navigation pages. From these deliverables, an HTML-prototype for the OSP and a Content Development Guide was derived. Both were subsequently tested with end users and content providers, respectively. The validated IA system was documented with an IA Style Guide and a final Content Development Guide. An additional evaluation was planned after the implementation of the redesigned IA system.

Initial Project Planning

Table 4-17 shows the initial project planning. To meet target criteria TC2 (efficiency of process instances; see 4.3.3), the project had to be completed within 120 person-days (which was the reference value defined for the available resources in the expert evaluation focus groups; see 4.6.3.3). The initial project planning involved 55 workdays (October 6 to December 19,

2003). The core project team included the author (performing the roles of project manager, information architect, and usability engineer), and two working students (for visual design and various project-related activities).

Table 4-17: Initial project planning for the SBS T&S Online Seminar Program (OSP)

#	Work Package Title	Start	End	Milestone
1	Discovery	10/06/03	10/10/03	
2	Analysis	10/13/03	10/31/03	
3	Design	11/03/03	11/14/03	Metadata schemata, Content Structure, Interaction Flows
4	Prototyping & Testing	11/17/03	12/05/03	HTML Prototype V0.1, Content Development Guide V0.1
5	Revision & Documentation	12/08/03	12/19/03	IA Style Guide, Content Development Guide V1.0

4.7.3 Methods and Materials: Validation Project Process, Methods, & Deliverables

4.7.3.1 Validation Project Phase 1: Discovery

*Methods and Deliverables in the Discovery Phase*¹²¹

Steps 1.1, 1.2, 1.3¹²²: *Stakeholder interviews* and *Kick-off workshop*: After several informal exploratory interviews with client stakeholders, the project was officially launched with a kick-off workshop. Participants included the project sponsor and responsible stakeholders of the client's Content Management, Sales & Marketing, and System Development departments (N=4). The workshop lasted three hours, and after a short introduction to IA, the project, and to the focus and objectives of the workshop, concentrated on gathering information about and establishing consensus on three major areas:

- Client's business context (business data, constraints, goals, requirements, competitors)
- Characteristics of the application OSP (e.g., current and planned scope of content & functionality, target user groups, goals, usage data and scenarios, constraints)
- Project Planning (e.g., project focus, goals, success criteria, work packages, milestones, team)

Participants were presented a digital mind map on a large video screen (6x8 ft; using a video projector connected to a notebook, and a software called MindManager™; see Figure 4-31), outlining key issues for each of these three areas, which amounted to 41 items. Each issue was

¹²¹ For all project steps, generic document templates were either available from CT IC 7's internal methods documentation or had been drafted prior to the OSP project. Unless otherwise stated, in the following, methods were performed by the author with additional support from working students.

¹²² Numbers refer to the project steps as defined in the IA Process Model V0.6

discussed in turn, and any relevant information was simultaneously recorded in the mind map by the author, thus being easily followed by each participant.

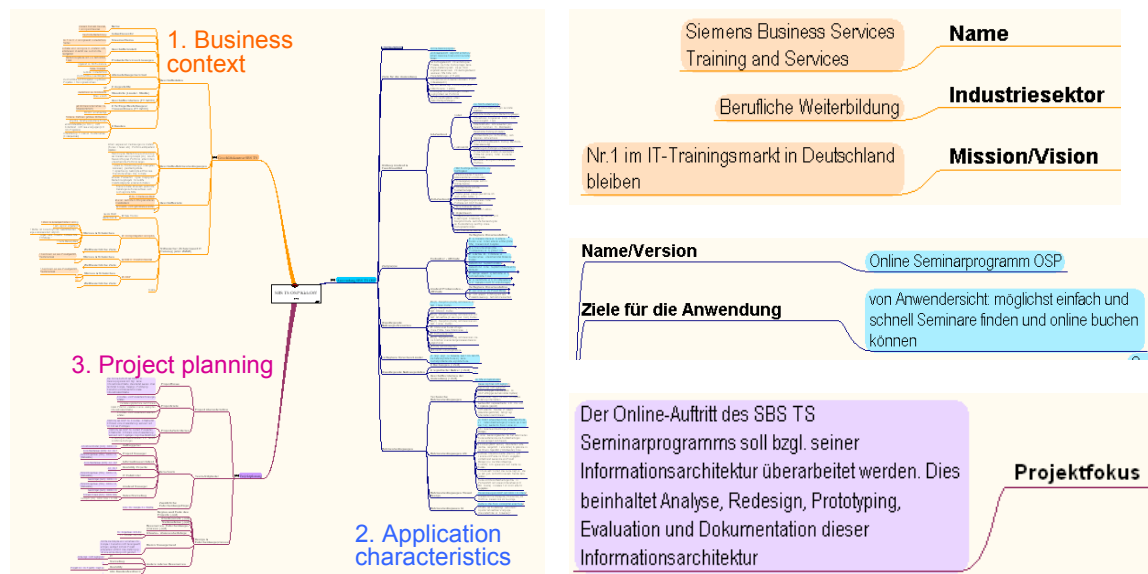


Figure 4-31: Overview and exemplary detailed items of the kick-off workshop mind map (in German)

A list of issues discussed is presented in Appendix B-5.1 with the Table of Contents for the resulting IA Business Brief. In the following, selected results are presented which are central to subsequent steps. Among project planning issues, detailed goals for the project were defined, which concretized the key target criterion TC1 (effective process instances) for the IA Process Model, as defined in 4.3.3:

Detailed target criteria for key target criterion TC1 (effective process instances):

TC1.1: improved user goal achievement: finding a seminar and making reservations as simply and quickly as possible:

TC1.1.1: # errors in finding a seminar and making a reservation <1 on average;

TC1.1.2: end users' subjective ratings > 80% of optimum values

TC1.2: improved business goal achievement:

Business goal #1: Raise proportion of online reservations ➔

TC1.2.1: percentage of online reservations > current state¹²³

Business goal #2: improve content management process ➔

TC1.2.2: content providers' subjective ratings > 80% of optimum values

¹²³ No exact figures for increase in percentage of online bookings were defined at this point. Due to the multitude of boundary conditions and dependencies, the current state of proportion of online bookings to be improved on with the redesigned IA system was to be measured just prior to deployment of the IA system.

Together with the random selection of the project (TC3) and the scheduled project duration of no more than 120 person-days (TC2), this completed the operationalization of target criteria for the IA Process Model.

Among the issues discussed regarding the characteristics of the application, usage scenarios and user roles were defined and prioritized, and additional input material was collected. The nine basic usage scenarios for the OSP were (from most to least relevant):

Basic usage scenarios (S) for the Online Seminar Program (OSP):

- S1** a (b): finding a seminar on a given topic using the navigation (search functionality), and making a reservation online
- S2** a (b): finding seminars at a given training site / date using the navigation (search functionality), and making a reservation online
- S3** a (b): finding seminars conducted with a particular teaching method (e-learning vs. classroom seminars) using the navigation (search functionality), and making a reservation online
- S4** a (b): finding seminars conducted by a particular trainer using the navigation (search functionality), and making a reservation online
- S5:** Checking the status of a particular seminar (further reservations possible, available hotel rooms)
- S6:** Cancel an existing seminar reservation
- S7** a (b): Finding seminars which follow a seminar in a given sequence using the navigation (search functionality), and making a reservation online
- S8:** Search for keywords using the search functionality
- S9:** Checking the personal booking history

Basic end user roles were specified as:

End user roles for the Online Seminar Program (OSP):

- DecM:** Decision maker approving an employee's participation
- RegO:** Registration officer booking seminars for other colleagues
- SemP:** Self-booked seminar participant

Basic content provider user roles defined were:

Content provider user roles for the Online Seminar Program (OSP):

- SemT:** Seminar trainer conducting the seminar
- ProdM:** Product Manager responsible for overall seminar planning

Additional input available included results from:

- a previously conducted focus group on the content structure within the seminar catalog
- a product testing study on professional education websites (Stiftung Warentest, 2003)

Step 1.3: An *IA Business Brief* was developed to document the resulting data. Appendix B-5.1 presents the detailed Table of Contents for the 26-pages business brief, detailing the type of information gathered during Discovery.

Process Flow During Discovery

During Discovery, the flow of input and output within the overall process flow was mostly linear (see Figure 4-32): information gathered in initial exploratory interviews was filled in the mind map prior to the kick-off workshop and presented to participants for validation. After the kick-off workshop on October 7, all information gathered was assembled in the IA Business Brief, which was then again distributed to team members on October 8 via email for validation. Feedback was incorporated in the IA Business Brief until October 13, and thus, the Discovery phase was completed with a negligible delay of one workday.

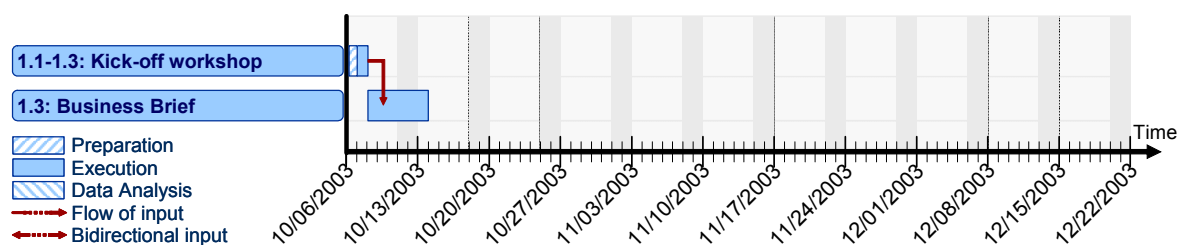


Figure 4-32: Process flow during Discovery
(start / end of project steps and major input flows)

4.7.3.2 Validation Project Phase 2: Analysis

Methods and Deliverables in the Analysis Phase

Step 2.2: *Content Inventory*: to identify the current state of the OSP's content, its structure, and navigation systems, a detailed content audit as described in 2.1.5.3 was performed. The resulting matrix (see Table 4-18) listed for each page:

- an unique ID
- page name (linked with the respective URL of the page)
- SBS-internal ID
- product version that includes the page (CD-ROM, Siemens-internal, and/or external website)
- page type¹²⁴

¹²⁴ Examples for page type include (1) navigation pages: topical seminar catalog, flow charts of sequences of seminars; (2) content pages: seminar description, training site description

The complete inventory consisted of 461 entries. For the lowest level of the seminar catalog (i.e., individual seminar description pages), only a few exemplary pages were included to minimize redundant analysis efforts.

Table 4-18: Excerpt of the content inventory performed on the OSP

ID	Page name & link	SBS ID	Version			Page Type
			CD-ROM	External	Internal	
OSP.0	Home-OSP		1	1	1	Navigation
OSP.1	Seminar offerings-topics		1	1	1	Navigation: topical catalog
OSP.1.1	Consulting	A010	1	1	0	Navigation: topical catalog
OSP.1.2	English Training Offerings		0	0	1	Navigation: topical catalog
OSP.1.2.1	Service (parts of C.1.9)		0	0	1	Navigation: topical catalog
OSP.1.2.2	IT-Security (parts of C.1.10)		0	0	1	Navigation: topical catalog
OSP.1.3	Operating systems	A020	1	1	1	Navigation: topical catalog
OSP.1.3.1	BS2000	A020-010	1	1	1	Navigation: topical catalog
OSP.1.3.1.1	BS2SDF-A: Modification and enhance- ment of the BS2000-SDF-user interface		1	1	1	Content: seminar description
OSP.1.3.1.2	BS2SY: Mode of operation of core BS2000 system compo- nents		1	1	1	Content: seminar description

Note. Translated from German.

Step 2.2: *Usability Inspection*: to discover usability deficits and respective improvement potentials of the current OSP, a heuristic evaluation as described in 2.2.6.1 was conducted. Two evaluators inspected the OSP, applying the list of heuristics proposed by Molich and Nielsen (see Nielsen, 1994) to four key scenarios:

- S1a: finding a seminar on a given topic (Basics of MS Word™) using the navigation, and making a reservation online
- S1b: finding a seminar on a given topic (Basics of MS Word™) using the search functionality (search query input: “word beginner”), and making a reservation online
- S2a: finding seminars at a given training site (Munich)/date (November 1st through 8th) using the navigation
- S2b: finding seminars at a given training site/date using the search functionality (search query input: “Munich”, “November 1st through 8th”)

Usability deficits, violated heuristics, and - where appropriate - change recommendations were noted individually by each evaluator, and then aggregated. Results were documented in a 34-slide PowerPoint™ presentation, illustrating each deficit with a screenshot of the respective page (see Figure 4-33 for an exemplary slide).


	<p>Scenario #: 2</p> <p>Step #: 8 (search results)</p> <p>Notes:</p> <ol style="list-style-type: none"> 1. query terms searched for are not displayed (H5) 2. no means of refining search results, e.g., with regard to training sites or date (H1) 3. no information on seminar duration, price, or training site available, even if search query included this – only possible by clicking “Seminar”, “Termine and Buchung” – no further information about topics of the seminar available (H5) 4. sorted alphabetically? risky: user only attend to the top-most items in a long list of hits; R: sort according to relevancy (H1) 5. no comparison between seminars possible, as back-functionality does not work from page with seminar description back to search results page (H3)
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Figure 4-33: Exemplary slide from the documentation of OSP usability inspection results (showing usability deficits for the search results page; translated from German)

Step 2.1: *Competitive Review*: to reveal competitive advantages and improvement potentials, a review of three competitors was performed. Similar in overall procedure to the previous usability inspection, the review involved an - albeit rather generic - heuristic evaluation (see 2.2.6.1) of the four key usage scenarios. In addition to major usability deficits, however, the analysts also recorded overall scope of content, functionality, and IA best practices of the respective websites. Results were documented in a 79-slide PowerPoint™ presentation as shown in Figure 4-33¹²⁵.

Step 2.2: *Stakeholder Interviews*: to identify the actual state of the OSP's technical backend, two semi-structured interviews focusing on the scope of currently existing databases were conducted with the responsible database manager. From that, tabular descriptions of the 11 most relevant data tables (see Appendix B-6 for an example), and a list of currently available but not used tables and functionalities were generated.

Steps 2.2, 2.5: *End user Feedback Analysis*: to discover additional usability deficits and respective end user requirements regarding the OSP, a list of customers' frequently asked questions regarding the OSP was analyzed qualitatively. The questions had been collected by the client's call center, where customers also could make reservations, or ask for specific help.

¹²⁵ Due to copyright issues, no competitor names and screenshots are included.

A semi-structured interview was conducted with a call center agent to discuss particular questions and the overall feedback customers gave on the OSP.

Step 2.3-2.6: *Consolidated Assessment*: to both analyze context of use and gather requirements of end users as well as content providers, Consolidated Assessment sessions were conducted, which combine three methods, and thus two process steps of the IA Process Model V0.6 (analysis of context of use and requirements gathering for both end users and content providers), into one single session:¹²⁶

- Scenario design exercise¹²⁷
- Card Sorting (as described in 2.1.5.2)
- Participatory Design (as described in 2.2.6.1)

This method was chosen as it best met the need for quick but meaningful results. Participants were recruited by an agent of the client's call center, who was given a recruiting script detailing requirements for potential participants (see Appendix B-6.2). In sum, nine end users and three content providers participated in the analysis (see Table 4-19 and Table 4-20).

Table 4-19: End user participants in the Consolidated Assessment sessions

ID	Job title	Siemens-affiliation	Company Size	EU User Role ^a	Subjective Internet experience
EU1	Office service specialist	External	Large	RegO	Advanced user
EU2	Service executive officer	External	Small	DecM, RegO	Expert
EU3	Line Manager	Internal	Large	RegO	Advanced user
EU4	Software Consultant	Internal	Large	SemP	Advanced user
EU5	Support Manager	Internal	Large	RegO	Advanced user
EU6	System engineer	External	Large	SemP	Expert
EU7	Laboratory assistant	External	Small	SemP	Advanced user
EU8	Software developer	Internal	Large	SemP	Expert
EU9	n.a.	External	Small	SemP	Expert

^a As defined in the Discovery phase (see 4.7.3.1): decision maker approving an employee's participation (DecM), registration officer making seminar registrations for other colleagues (RegO), or self-booked seminar participant (SemP)

Table 4-20: Content Provider participants in the Consolidated Assessment sessions

ID	Job title			CP User Role ^a	Subjective Internet experience
CP1	Senior Designer			ProdM	Advanced user
CP2	Educational Services Consultant			SemT, ProdM	Advanced user
CP3	Product manager			ProdM	Expert

^a As defined in the Discovery phase (4.7.3.1): seminar trainer conducting the seminar (SemT), or product manager responsible for overall seminar planning (ProdM)

¹²⁶ For details, see Gordon (2002)

¹²⁷ A scenario design exercise, in this context, is in essence identical to a talk-through as described in 2.2.6.1: an interview focusing on how the interviewee performs a particular task.

Each session lasted about 1.5 hours, and was conducted in a one-on-one setting at the interviewee's workplace, with an additional note-taker available in most sessions. Prior to each session, participants were sent an email with an attached questionnaire on basic personal and job-related data, with additional questions covering the participant's computer / internet experience, hardware and software equipment, and the physical / social work context (see Appendix B-6.2). Participants were free to either fill in the questionnaire online and send it back via email, or print it on paper, fill it in, and bring it to the session. After each session, participants were compensated with small presents (each worth \$10-15). After an initial welcome and introduction to the focus and goals of the session, the basic Consolidated Assessment procedure for end users involved the following five steps:

1. Participants were given nine cards, each outlining one of the nine basic usage scenarios. Participants were instructed to sort scenarios according to how relevant they were to them and how reflective scenarios were of their usage of the OSP. Here and in all subsequent steps, important issues raised by the participants were noted by the researcher.
2. To analyze in detail the context of use, participants were asked to describe, for the scenario rated as most important, how they usually perform this task, what resources they require, and which problems had occurred in the past. The interviewer noted each step and any relevant issues described by the participant.
3. To gather and prioritize content and functionality requirements, participants were given 44 cards, each denoting a current or potential new content element (23 white cards) or functionality (21 yellow cards) of the OSP, as defined in the Discovery phase (for a complete list of cards given to end users, see Appendix B-6.2). For the most important scenario, participants then sorted cards into five categories indicating importance.¹²⁸
4. To gather IA and interface requirements, participants were handed sheets of paper with an image of a blank browser window (see Appendix B-6.2), together with a set of differently colored pencils. Again for the most important scenario, participants were asked to sketch out, in rough terms, the basic look of each screen involved, including aspects of content, layout, navigation, and functionality. After completion, they were prompted to assign each of the "important" and "rather important" content element

¹²⁸ Categories for "Importance" were illustrated with another five cards in red, labeled "important", "fairly important", "nice to have, but not important", "fairly unimportant", and "unimportant".

and functionality cards to a screen sketch for which this content element / functionality was most important to them.

5. Finally, participants were given the opportunity for overall feedback on the OSP, accessing and using the OSP with their desktop PC, if needed.

Data analysis was performed both quantitatively and qualitatively. For all card sortings (step (1) and (3)), median values were computed (see Appendix B-6.2). The descriptions of the most important scenario across all end users (scenario S1) were averaged and translated into two overall task flow diagrams (see Figure 4-34).

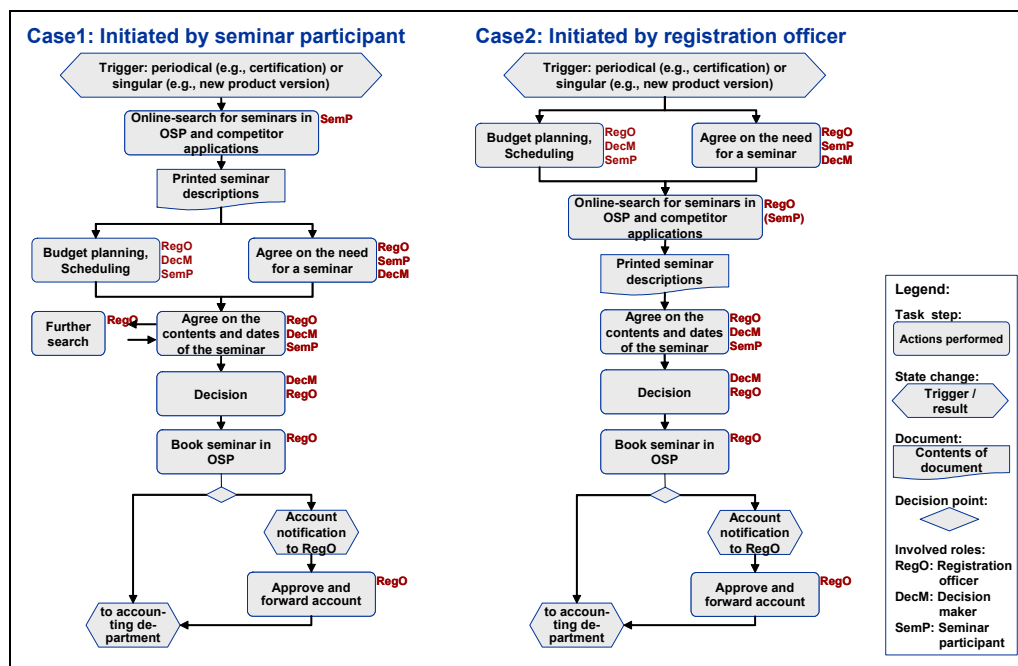


Figure 4-34: Overall task flow diagram for basic usage scenario S1 (finding a seminar on a given topic and making a reservation online; initiated either by the seminar participant (SemP, case 1) or by the registration officer (RegO, case 2))

The screen sketches (for an example, see Figure 4-35, left image) were averaged across all end users, and by fixing them to a large (4 x 7 ft.) pin board, a generic *interaction flow*¹²⁹ diagram was derived (see Figure 4-35, right image). To each screen (i.e., generic interaction step), “very important” and “important” content / functionality elements (as assigned in step (4)), and any additional issues raised during the sessions were attached.

Among other issues, overall results showed:

¹²⁹ In this context, an *interaction flow* can be defined as the part of the overall *task flow* that takes place in interaction with the system.

- Significant differences between novice and expert users¹³⁰
- A need for decision-critical information, at the right place and time, in adequate detail
- Insufficient IA and interface design¹³¹

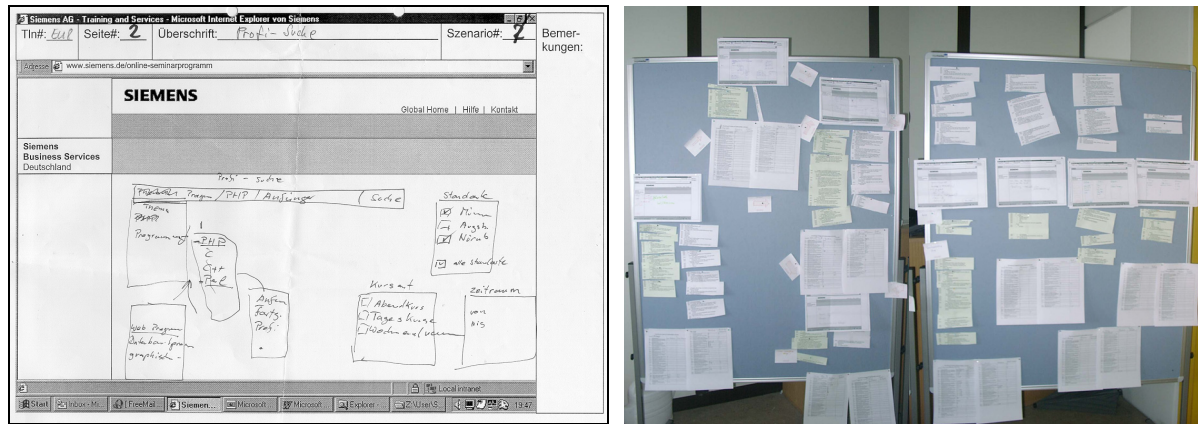


Figure 4-35: Exemplary screen sketch from the end user Consolidated Assessment sessions (left: advanced search screen) and pin-board based generic interaction flow derived from these (right)

For content providers, the basic method remained unchanged, except for these modifications:

- Step (1) was skipped, as only one scenario was analyzed (“developing a new/revising an existing seminar description”).
- This scenario was then analyzed in step (2), in order to examine the current Content Management Process as performed in reality, including any problems involved.
- In step (3), content providers sorted 22 white cards for existing OSP content elements to be delivered by them according to the level of effort involved into five categories¹³².
- For step (4), the sketching of screens was replaced with gathering content providers’ overall feedback on the OSP in a semi-structured interview manner. Content providers were shown screenshots of the current OSP and asked for their overall satisfaction with various aspects (e.g., content structure, layout, metadata assignment; for a complete list, see Appendix B-6.2). Answers were rated by both the interviewer and note-taker on a five-point scale (1 = low satisfaction, 5 = high satisfaction).
- An additional step (5) was introduced to assess content providers’ additional effort for potentially new features of the OSP. They were asked to sort 12 cards, each denoting a

¹³⁰ Examples for significant differences between expert and novice users: additional help and guidance required for novice user; need for quicker access to content and booking for expert users

¹³¹ Examples for insufficient IA system and interface design: inconsistent and mixed-up navigation systems; seminar description does not allow for quick overview on goals and benefits; layout too cluttered for seminar description pages; icons for seminar status not self-explanatory.

¹³² Categories for "Level of effort" were illustrated with another five cards in red, labeled "high effort", "fairly high effort", "average effort", "fairly low effort", "low effort".

potential new content or functionality element, into the five “level of effort”-categories.

The analysis of the card sorting results in step (3) and (5) remained identical to the previous end user results analysis. Similarly, for step (4), ratings for overall satisfaction were averaged using the median value of both interviewer and note-taker ratings (for results, see Appendix B-6.2). Data from step (2) and notes were analyzed qualitatively. Major results included:

- Deficits of the current Content Management Process, resulting in IA system deficits¹³³
- Additional details of current IA system and Content Management Process¹³⁴
- Additional technical constraints for the IA (related to the implementation in SAP R/3)
- Inadequacies of current IA system¹³⁵
- Frequent end user problems, learned through direct interaction with end users¹³⁶
- OSP design change suggestions derived from personal requirements¹³⁷

Step 2.7: *IA Analysis Report and Presentation*: the results of the analysis phase were documented in an 89 slide PowerPoint™ file (see Appendix B-6.3 for a Table of Contents) and presented to clients in a 3-hour meeting. Participants (N=6) included the project sponsor and another five responsible stakeholders of the client’s Content Management, Sales & Marketing, and System Development departments. After presenting and discussing major results, participants were asked to rate potential new content and functionality elements for the future OSP according to two criteria:

- Technical feasibility (1=low feasibility, 5=high feasibility)
- Relevancy for business goals achievement (1=low, 5=high relevancy)

Paper sheets with requirements were handed to stakeholders for each to individually note down ratings. Four out of the six participants gave ratings for relevancy for business goal

¹³³ Examples for Content Management Process problems: unavailability of basic documentation; no explicit textual and formal standards; lot of collaboration necessary for diagrams on seminar sequences, seminar content, goals, and prices; need for explicit eye catcher in seminar description; inadequate allocation of responsibilities within process; infrequent updates (“last update 2001”).

¹³⁴ Examples for additional details: contents and duration of seminars determined in cooperation with respective trainer; text for seminar description is not to be longer than 19 rows.

¹³⁵ Examples for inadequacies of current IA system: seminar catalog content structure: too many items on first level; complex and inconsistent structure; need for more detailed structure; current separation of “goals” and “benefits” within a seminar description not practicable; need for including seminars from other main chapters to a chapter; inadequate layout: header too big, inadequate typeface; too many screens needed for one seminar description; need for PDF / MS Word files of seminar descriptions; missing linking facilities for related, pre- and post seminars, internet resources; no documented standard (no controlled vocabulary) for “keywords” and technical term definitions.

¹³⁶ Examples for frequent end user problems: no easy access to OSP website from Siemens homepage; labeling problems; need for PDF files of overall chapters of the seminar catalog; icons not self-explanatory.

¹³⁷ Example for design change suggestions: on the homepage, emphasize the unique selling points of SBS T&S.

achievement, and three for technical feasibility. After the presentation, median values for the ratings were computed. A matrix was added to the IA Analysis Report, which listed overall level of feasibility (x-axis) and level of relevancy (y-axis) for these key requirements (see Figure 4-36)¹³⁸. The respective values for the matrix were computed as follows:

$$\text{Overall feasibility} = \frac{\text{technical feasibility} + \text{feasibility for content providers}}{2} \quad (139)$$

$$\text{Overall relevancy} = \frac{\text{relevancy for business goal achievement} + \text{relevancy for end users}}{2} \quad (140)$$

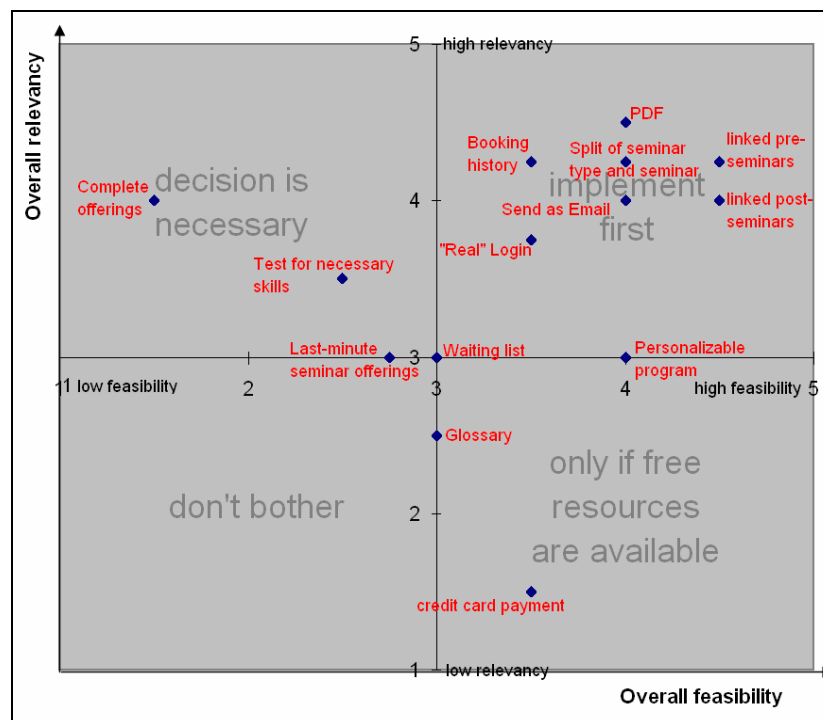


Figure 4-36: Overall feasibility and relevance of potential new content / functionality elements for the OSP¹⁴¹

Process Flow During Analysis

According to the IA Process Model V0.6, the Analysis phase was launched after the kick-off workshop on October 8 with a fairly parallel analysis of the actual state of the OSP (Step 2.2; methods used: *Content Inventory* and *Usability Inspection*) and competitor websites (Step 2.1; method used: *Competitive Review*). *Stakeholder Interviews* (Step 2.2) were dependent on information from the IA Business Brief, and thus, started later on (see Figure 4-37).

¹³⁸ For a similar display of prioritized requirements, see Fraser (2002).

¹³⁹ Values for feasibility for content providers as obtained in the respective Consolidated Assessment sessions with content providers (ratings for level of effort necessary for potential new content elements were inverted to feasibility values: thus, effort=5 was inverted to feasibility=1, and effort=1 was inverted to feasibility=5)

¹⁴⁰ Relevancy for end users as obtained in the Consolidated Assessment sessions with end users

¹⁴¹ For descriptions of single elements, see Appendix B-6.2

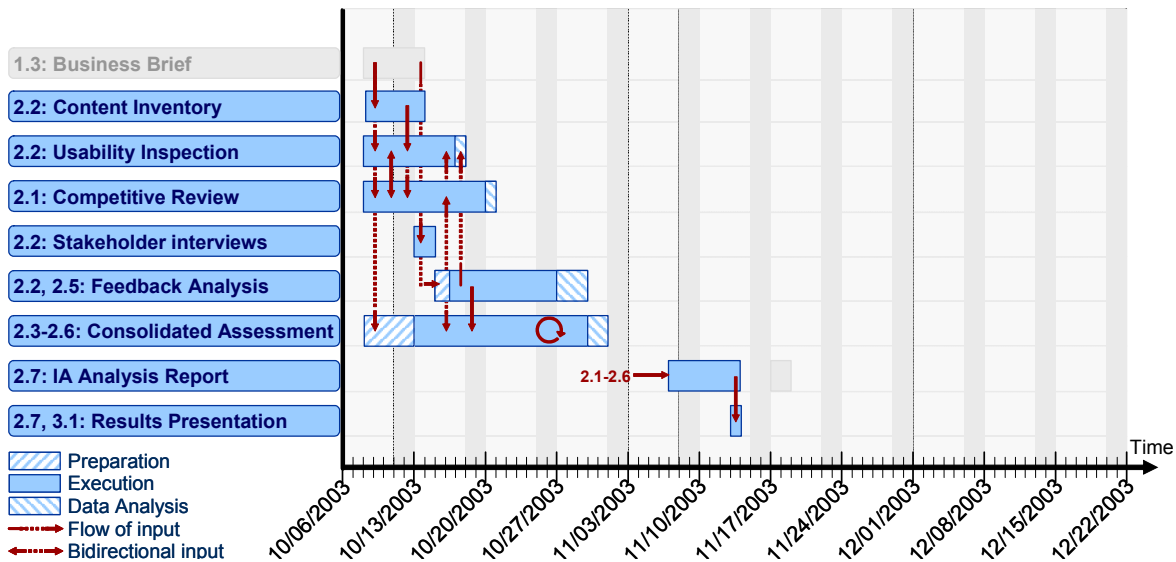


Figure 4-37: Process flow during Analysis
(start / end of project steps and major input flows)

Analysis of context of use and requirements gathering of both end users and content providers (Steps 2.3-2.6; method used: *Consolidated Assessment*; also Step 2.5: *Feedback Analysis*) were performed in parallel; in accordance with the IA Process Model V0.6, actual end user / content provider sessions started only after preliminary results of previous steps were available (on October 10). The IA analysis report (Step 2.7) was created after all previous steps were completed, and the presentation was conducted subsequently. On client request, the fixed date for this presentation was postponed from November 4 to November 13, thus, the Analysis phase was completed with a delay of seven workdays compared to initial planning. For details on the flow of input between project steps, see Appendix B-6.4.

4.7.3.3 Validation Project Phase 3: Design

Methods and Deliverables

Step 3.1: *Prioritization, project phasing, and strategy development*: to project the Design phase, decisions on focus and scope of the redesign were derived in discussions with the client stakeholders. Thus, the IA Design phase was decided to:

- focus redesign efforts on the most important scenario
- cover only highly relevant and feasible features (first quadrant in Figure 4-36)¹⁴²
- emphasize novice and expert usage, adequate presentation of critical information
- take over existing content structure for the seminar catalog¹⁴³

¹⁴² Thus, redesign efforts also did not require major database changes. Deeper-reaching changes (including the design of a search thesaurus) were delayed to later design iterations.

Step 3.2, 3.3, 3.5: *Content Requirements Collection*: throughout the Design phase, requirements regarding semantic and formal content characteristics were collected and organized in an MS Word™ file as a basis for the Content Development Guide.

Step 3.2, 3.5: *ERD Data Modeling*: to align the design of the IA system with the underlying database, initially the collaborative development of Entity Relationship Diagrams (ERD) was planned. However, as defined for the Design strategy, no major changes to the existing data model were allowed in this project, and therefore, no ERDs were necessary. Throughout the Design phase, therefore, data modeling instead focused on ensuring that the redesigned IA system can be implemented with the existing database system, which was achieved in several discussions with the responsible database manager.

Steps 3.3, 3.4: *Blueprints* (Organization and Interaction Documentation; see 2.1.5.5): as defined above, the overall content structure and content model was taken over from previous focus group results; thus, no explicit organization documentation blueprints were created. To arrive at the detailed interaction flow, the generic interaction flow diagram (see Figure 4-35 on Page 175, right image) from the Analysis phase was sketched on a large (4 x 5 ft.) paper-board. This generic interaction flow was supplemented with any additional interactions steps essential to scenarios S1 and S8 (e.g., setting up a new account), resulting in a detailed interaction documentation blueprint. The blueprint listed every single interaction step, i.e., every screen of the OSP traversed by the user performing scenarios S1 or S8 (see Figure 4-38 for a PowerPoint™-based, detailed interaction flow for booking a seminar). This preliminary detailed interaction flow was validated and refined in an informal walkthrough (duration: 1h) with two Usability Engineering / Visual Design experts of CT IC 7.

¹⁴³ This existing content structure was defined in a previously conducted end user focus group, thus already incorporating user needs (see 4.7.3.1).

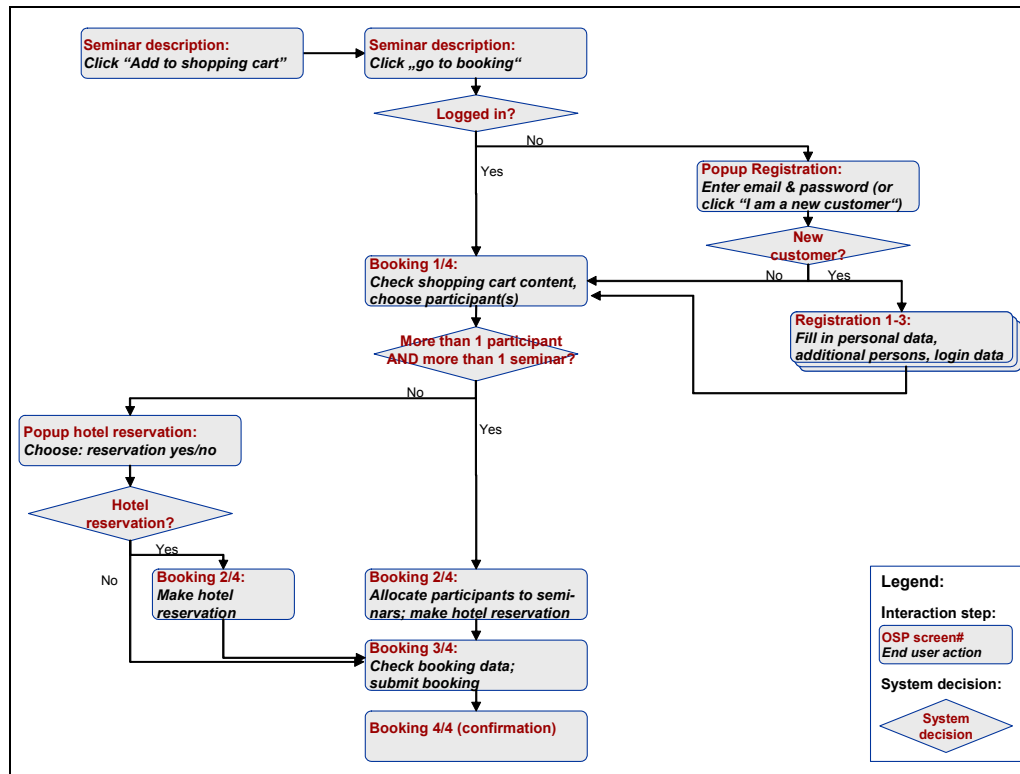


Figure 4-38: Detailed interaction flow for booking a seminar¹⁴⁴

Step 3.4, 3.6, 3.7: *Wireframes*: to design and document content, functionality, navigation/search, and overall layout for each screen, low and high fidelity wireframes (as described in 2.1.5.4) were sketched on paper and refined in MS PowerPoint™ (see Figure 4-39). Major constraints¹⁴⁵ for wireframe design were:

- the top third of the screen was reserved for corporate-wide Siemens branding and navigation (see Figure 4-39, left image) and thus could not be used for the OSP
- basic layout, typography, and color scheme had to conform to corporate online style guides

Wireframes were developed by the information architect in collaboration with a visual designer (see below), for all screens of scenario S1a, including logged-in/logged-out variants, for setting up a new account, and for advanced search screens (accounting for scenario S1b, S8), amounting to 30 individual wireframes.

¹⁴⁴ Translated from German.

¹⁴⁵ These constraints, among others, were gathered in the kick-off workshop during the Discovery phase and documented in the IA Business Brief (for a Table of Contents of the IA Business Brief, see Appendix B-5.1)

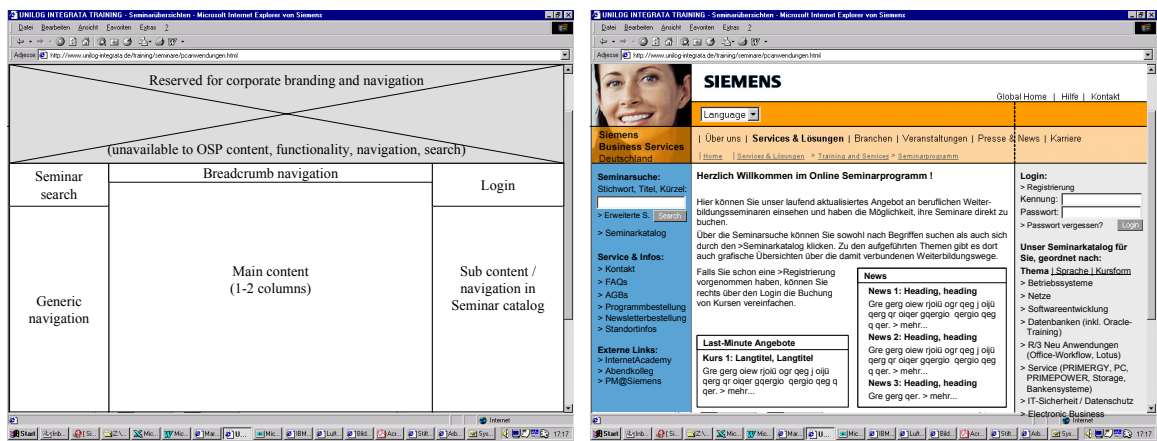











Figure 4-39: Exemplary low (left) and high (right) fidelity wireframes for the OSP (left: generic layout, translated from German; right: OSP homepage)

Steps 3.6, 3.7: *Visual Design*: visual design activities were carried out by one of CT IC 7’s visual design working students, and covered design of images and icons (see Table 4-21, Figure 4-40), as well as co-developing the overall wireframes. Like wireframes, Visual Design deliverables had to comply with corporate online style guides. Therefore, icons for functions were largely derived from templates included in the corporate online style guides (e.g., an icon for print version of a page; see Table 4-21, right column).

Table 4-21: Icons designed for the OSP

Teaching method ^a		Booking status ^b		Functions	
	Computer/web-based training		No reservations but waiting list available	 Druckversion	Print version of the current page
	Daytime seminar		Only a few reservation still available	 PDF	PDF-file of the current page
	Evening time seminar		Reservations available	 Als Email	Send current page as email

^a Icon size = 200% of original

^b Icons depict red, yellow, and green (traffic) lights (from top to bottom row); icon size = 200% of original

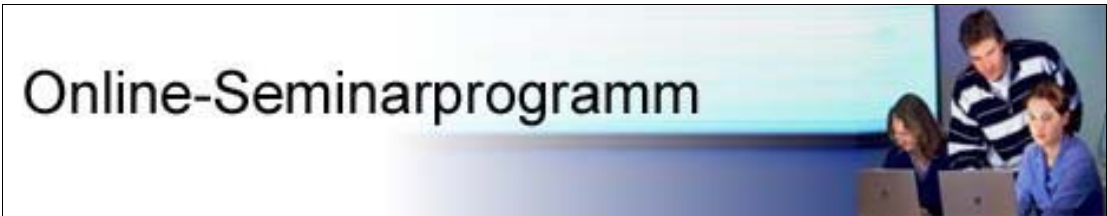


Figure 4-40: Homepage banner designed for the OSP

Process Flow During Design

Design activities started already on October 30 with developing *Blueprints* (Steps 3.3, 3.4; see Figure 4-41), followed by initial *Wireframes* (November 4 onwards; Steps 3.4, 3.6, 3.7) and *Visual Design* activities (November 7 onwards; Steps 3.6, 3.7; see Figure 4-41). Throughout

all Design steps, formal and textual *Content Requirements* were collected in parallel (Step 3.2, 3.3, 3.5). The overlap of Analysis and Design phase is, strictly speaking, not in line with the IA Process Model V0.6; however, in order to account for the delay of the Analysis phase, design activities that did not immediately require results from *Prioritization / Phasing / Strategy* were brought forward, and started as soon as immediate analysis activities (Steps 2.1-2.6) were completed. The actual prioritization of requirements, project phasing, and overall IA strategy development was launched during the *IA Analysis Results Presentation*. Subsequently, design activities were accordingly adjusted, and aligned with *ERD Data Modeling* activities (these were also postponed due to the non-changeable status of the data model that allowed only for matching results from other Design activities against the existing data model, and due to the need for input from *Prioritization / Phasing / Strategy*). Due to time constraints, no formative testing of Design deliverables was performed. The Design phase was completed only on November 29, amounting to a delay of 11 workdays. For detailed descriptions of the flow of input between project steps, see Appendix B-7.1.

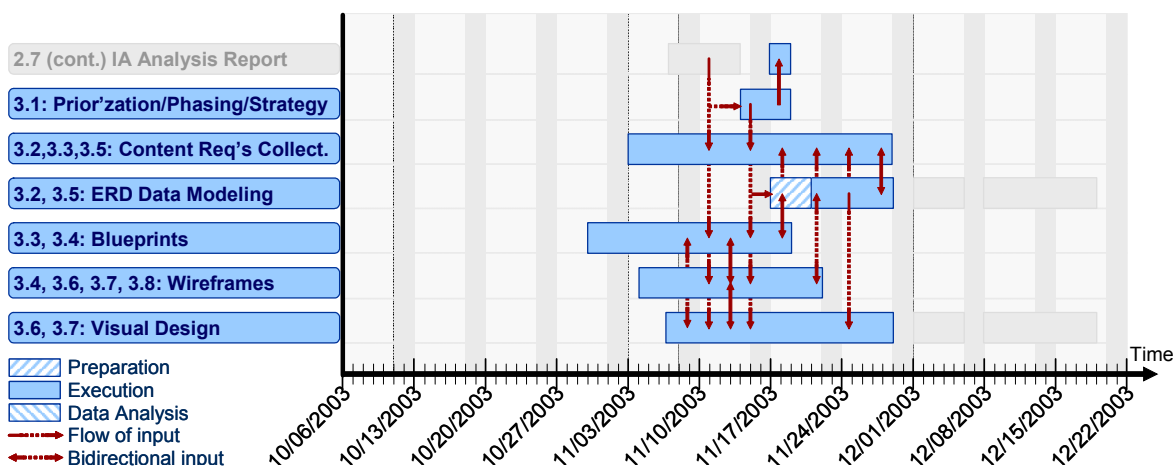


Figure 4-41: Process flow during Design:
(start / end of project steps and major input flows)

4.7.3.4 Validation Project Phase 4: Prototyping and Testing

Methods and Deliverables

Step 4.1: *Content Development Guide V0.1*: to allow content requirements to be evaluated by content providers with regard to accuracy and practicability prior to implementation, requirements were documented in a preliminary draft (V0.1) for the final Content Development Guide. The draft included 24 pages of specific semantic and formal content requirements for the three major content type classes of the OSP (seminar descriptions, training site descriptions, and diagrams showing a sequence of seminars), including specifications of individual metadata attributes and respective controlled vocabularies. Requirements involved a variable

degree of compulsiveness (mandatory standards vs. guidelines vs. optional recommendations), and were supplemented with general advice on creating high-quality web content (see Appendix B-8.1 for the Table of Contents).

Step 4.2: *OSP Prototype V0.1*: in order to be able to test the redesigned IA system with end users, an interactive, high-fidelity, computer-based (HTML) prototype (as described in 2.2.6.1) of the OSP was developed using Macromedia Dreamweaver™ (see Figure 4-42).

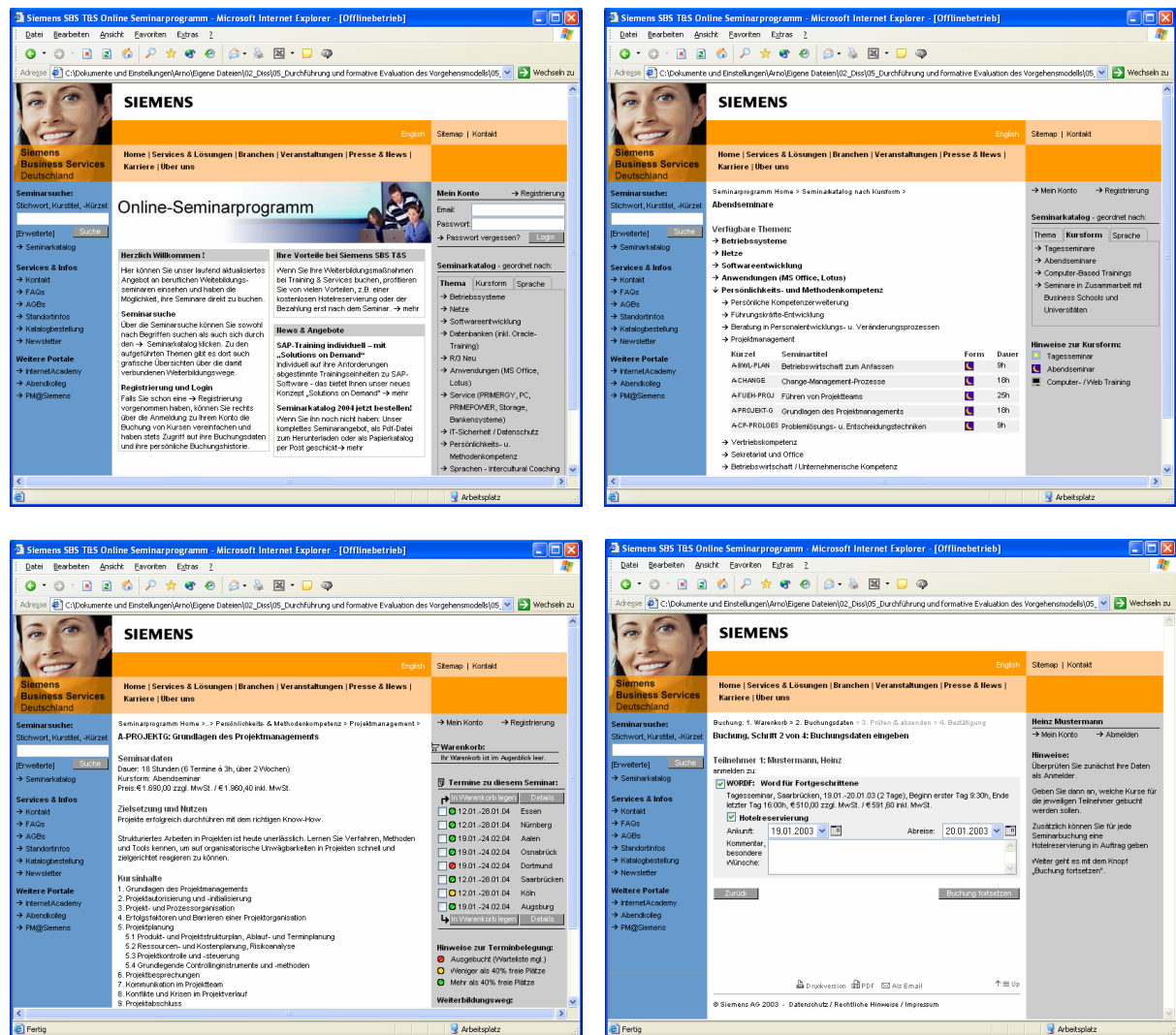


Figure 4-42: Screenshots from the OSP Prototype

Top left: homepage (logged out): right pane provides first level navigation of (topical) seminar catalog
Top right: seminar catalog (logged out): right pane presents seminar catalog filtered for teaching method
Bottom left: seminar description (logged-in): right pane shows login data and functionality, shopping cart contents, seminar dates/ venues, and booking status
Bottom right: booking interaction flow, step 2/4 (logged-in): provides functionality for allocating participants to seminars and making hotel reservations

The prototype included 68 individual HTML pages, allowing seven basic usage scenarios to be performed, including respective variants (logged-in vs. logged-out status, account already

in place vs. account yet to be set up)¹⁴⁶. Due to the hard-coded character of functionalities (e.g., display of shopping cart contents, personal account data display), however, for each scenario, correct screen display could only be ensured for one or two pre-defined interaction flows.

Steps 3.2, 3.5: (continued): *ERD Data Modeling*: to keep both prototypes aligned with the constraints of the existing and not-to-be changed data model, data modeling activities as described for the Design phase were continued during Prototyping.

Steps 3.6, 3.7: (continued): *Visual Design*: to fine-tune and adjust the visual design to the OSP prototype, visual design activities as described for the Design phase were also continued during Prototyping.

Step 4.3: *Content Provider Walkthrough*: to evaluate the Content Development Guide V0.1 for accuracy and practicability, a Cognitive Walkthrough was performed with each of the three content providers that had already participated in the Consolidated Assessment sessions (see Table 4-20 on Page 172 for details). Walkthroughs lasted about 1 hour; they were conducted by one researcher and one note-taker at the participant's workplace. At the beginning of the session, participants were introduced to the focus, goals, and overall procedure of the meeting. It was pointed out that it was the guide that was tested, not them. After that, they were explicitly requested to think aloud during the session and asked to sign an informed consent clause to explicitly obtain permission for taking pictures of the participant during the test session and to notify participants of their obligation to maintain confidentiality (for the original briefing script and consent clause, see Appendix B-8.2). Then, they were provided with the printed Content Development Guide V0.1, and instructed to envision developing a new seminar description with the guide. Subsequently, participants were introduced to each chapter of the guide stepwise and asked to comment on the accuracy and practicability of any guideline or standard, and to identify and name potential difficulties with implementing the respective guidelines and standards. Overall feedback and individual difficulties were noted as the walkthrough proceeded. At the end of each session, participants were asked to fill in a focused 5-UD questionnaire, concentrating on the usability of the guide as perceived by them. The 5-UD was chosen due to its short completion time, which was a vital prerequisite for ensuring content provider participation and commitment. Participants were explicitly notified of the equal distance between data points for each scale of the 5-UD. Table 4-22 shows the focused items of the questionnaire.

¹⁴⁶ Scenarios accounted for in the prototype included S1, S2b, S3, S5, S7a, S8, and S9. See 4.7.3.1 for details.

Table 4-22: Focused 5-UD questionnaire items for the Content Provider Walkthroughs

Dimension	Item
Efficiency	"How efficient do you feel you create a seminar description with this CDG?"
Affect	"Do you like using this CDG?"
Helpfulness	"Does this CDG help you how to use it?"
Control	"Do you feel in control when creating a seminar description with this CDG?"
Learnability	"Do you think it is easy to learn to create a seminar description with the CDG?"

Note. Translated from German; for the original, see Appendix B-8.2.

Results of the Content Provider Walkthroughs showed overall positive results (see Figure 4-43). For the 5-UD questionnaire, all of the five scales showed positive mean ratings. Maximum positive ratings were obtained for “efficiency” ($M = 8.0$, $SD = 0$) and “helpfulness” ($M = 8.33$, $SD = 1.15$), supporting the assertion that the Content Development Guide indeed supports effective and efficient content production. The lower score for “control” ($M = 7.0$, $SD = 1.73$), possibly illustrating a minor feeling of being controlled on the content providers’ side, in fact only mirrored the deliberate goal for the Content Development Guide to diminish an undue degree of freedom in creating seminar descriptions for the OSP, in order to achieve consistent and high-quality content across providers. The actual score for “control”, however, is nevertheless mid-positive, thus, overall, content providers still feel sufficiently in control of their actions. The - even if only perceived - increase in restrictions, however, might also be accountable for the lower and only slightly positive score for “affect” ($M = 6.33$, $SD = 1.53$), despite strong positive “efficiency”, “helpfulness”, and “learnability” scores. This strong positive score for “learnability” ($M = 7.67$, $SD = 1.15$), together with the strong positive “efficiency” and “helpfulness” scores, also corroborates the assumption of the Content Development Guide allowing for novice content providers to create a correct seminar description in a self-directed and efficient manner.

Additional results were obtained by qualitative analysis of the feedback given by content providers during the walkthroughs. Content providers emphasized the benefits of the guide especially for novice content providers, and valued the reduced need for personal inquiries in creating correct and consistent seminar descriptions. Key issues that were to be accounted for in subsequent versions of the Content Development Guide included:

- erroneous/imprecise/missing information in semantic/formal requirements¹⁴⁷
- unachievable requirements/inadequate level of compulsiveness of requirements¹⁴⁸

¹⁴⁷ Examples for incorrect / imprecise / missing information: semantic: the availability of seminars as in-house trainings should be explicitly mentioned; formal: length of description of seminar contents have to be no more than 60 characters for each of 19 rows)

- missing rationale for single requirements¹⁴⁹
- configuration of controlled vocabularies: missing/inadequate entries¹⁵⁰
- OSP design change suggestions derived from personal end user feedback¹⁵¹

The overall affirmative judgments of content providers were confirmed by similar positive feedback from the client's content management stakeholders during several discussions.

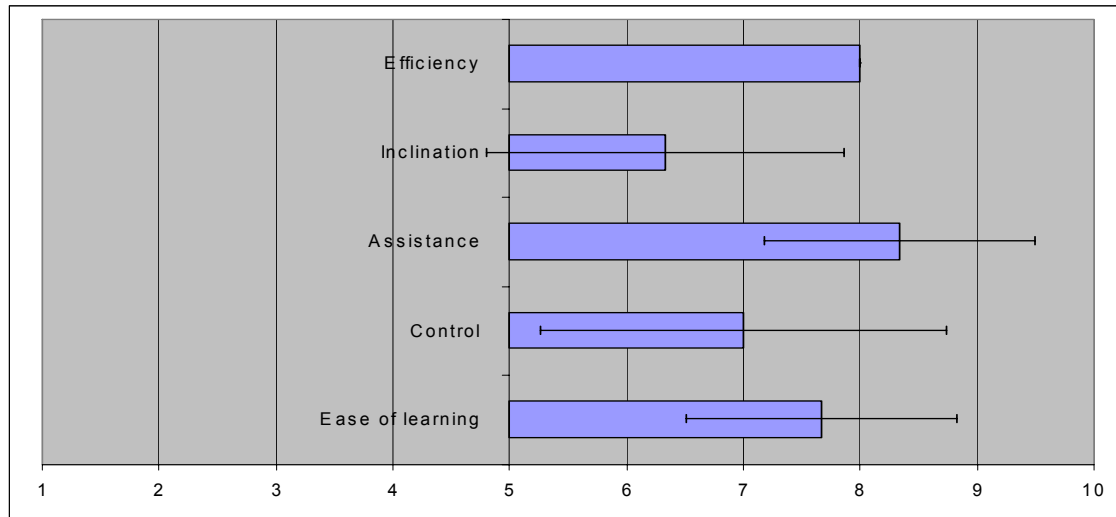


Figure 4-43: Results from the 5-UD questionnaire, across content providers (mean values and standard deviations)

Step 4.4: End User Usability Test: to evaluate the usability of the OSP Prototype V0.1, summative usability tests with a medium level of formalization (as described in 2.2.6.1) were conducted. Participants included 11 end users of the OSP (see Table 4-23). Each of them had performed at least one reservation within 12 months prior to testing. EU1 through EU5 had already participated in the Consolidated Assessment sessions; the remaining six participants were recruited in seminars concurrently conducted by the client.

Table 4-23: End user participants in the OSP Prototype Usability Test

#	Job title	Siemens-affiliation	Company Size	EU User Role ^a	Subjective Internet experience
EU1	Office service specialist	External	Large	RegO	Advanced user
EU2	Service executive officer	External	Small	DecM, RegO	Expert user
EU3	Line Manager	Internal	Large	RegO	Advanced user
EU4	Software Consultant	Internal	Large	SemP	Advanced user

¹⁴⁸ Example for unachievable requirements/inadequate level of compulsiveness: syntax for short name of seminars cannot be adhered to for all seminars

¹⁴⁹ Examples for missing rationale for single requirements: introductory sentence for seminar objectives should be short, because it is also used for mouse-over information.

¹⁵⁰ Examples for missing/inadequate entries of controlled vocabularies: missing CV elements for metadata “target audience for the seminar”

¹⁵¹ Example for OSP design change suggestions derived from personal end user feedback: add postal address under contact information.

EU5	Support Manager	Internal	Large	RegO	Advanced user
EU10	Consultant	External	Large	SemP	Advanced user
EU11	Data Processing Engineer	External	Large	SemP	Expert user
EU12	System Engineer	n.a.	Small	SemP	Expert user
EU13	IC-Support Engineer	Internal	Large	SemP	Advanced user
EU14	Services Engineer	Internal	Large	SemP	Advanced user
EU15	n.a.	External	Large	SemP	Expert user

^a As defined in the IA Business Brief (see 4.7.3.1): decision maker approving an employee's seminar participation (DecM), registration officer booking seminars for other colleagues (RegO), or self-booked seminar participant (SemP)

Each usability test session lasted about 1.5 hours. Tests were conducted in a one-on-one setting at the participant's workplace, with an additional note-taker available in most sessions. Unless already obtained in previous sessions, test participants were given a questionnaire on their overall context of use prior to the session (identical to the previous Consolidated Assessment questionnaire; see Appendix B-6.2), and asked to fill it in and bring it to the session. Again, after each session, participants were compensated with small presents (each worth \$10-15). At the beginning of each session, participants were welcomed and introduced to the focus, goals, and overall procedure of the session. It was pointed out that it was the OSP prototype that was tested, not them. Participants were asked to think aloud during the session (for the original briefing script, see Appendix B-8.3). Each participant was requested to sign an informed consent clause to obtain explicit permission for taking pictures of the participant during the test session and to notify participants of their obligation to maintain confidentiality (see Appendix B-8.3 for the original clause). For the actual test, participants were presented with six test scenarios (TS), derived by detailing and aligning basic usage scenarios with the OSP Prototype V0.1.¹⁵² Test scenarios included (translated from German):

Test scenarios (TS) for the end user usability tests:

TS1: *Description:* You want to know what seminars will be held in the near future in Munich covering „MS Word for advanced users“. *Instruction:* Select an appropriate seminar. Find out what dates are there for Munich and the respective seminar.

TS2: *Description:* You want to attend a seminar on “MS Word for advanced users”, and you would like to make the reservation online using the OSP. As this is your first time, you do not have login name or password yet. *Instruction:* Select an appropriate seminar. Make your reservation using the OSP.

TS3: *Description:* You want to attend a seminar on “MS Word for advanced users”. In addition, a colleague of yours wants to attend a seminar on “Object-oriented programming in C++”. You are assigned to make reservations for the both of you, and, as far as possible, also to make hotel reservations. *Instruction:* Select the appropriate seminars and make

¹⁵² As defined in the IA Business Brief (see Appendix B-5.1)

the reservations including hotel reservations for both you and your colleague. [login-data and personal data of colleague provided]

TS4: *Description:* The colleague of you, for whom you now already have made several reservations, asks you for an overview on the reservations you made for him. *Instruction:* Use the OSP to create an overview on all reservations you have made for your colleague, and send this overview to him by email.

TS5: *Description:* You want to attend a seminar on “Basics of project management”. Due to constraints of your daytime job, this would be only possible in an evening time seminar. *Instruction:* Select the appropriate evening time seminar and make the reservation. Print the final reservation confirmation.

TS6: *Description:* You want to acquire knowledge on “Object-oriented programming in C++” until February 2004. Due to your company’s limited budget for further training, this would only be possible with travel expenses kept to a minimum. Thus, you want to attend a seminar in Munich (your supposed hometown). *Instruction:* Use the OSP’s advanced search functionality to find a seminar that takes place in Munich until February 2004, and make a reservation for this.

Participants were presented one test scenario at a time. They were asked to read aloud the test scenario and respective instructions, and then to solve the task using the OSP prototype V0.1, verbalizing their thoughts as they proceeded. Participants interacted with the prototype using a notebook with a 15” screen display, a regular computer mouse, and a standard internet browser (MS Internet Explorer™ V6.0). Due to the limited functionality of the prototype, one function (making a selection in a pop-up window leading to the pop-up window being closed and to the next screen of the interaction flow being displayed in the original browser window) had to be simulated by the researcher in two instances. Hints were given when a participant was stuck, and said so. Mistakes (i.e., aberrations from the correct interaction paths for each test scenario) made by the participants and hints given were noted down by the researcher, as well as relevant comments of the participant. After each test scenario, participants were asked to fill in a standard 5-UD questionnaire (see Chapter 2.2.6.1) to evaluate end users’ perceived usability of the OSP prototype V0.1 for each test scenario.¹⁵³ The 5-UD was chosen because its short completion time allowed for administration after each test scenario, which was essential for being able to separately evaluate support of simple tasks (TS1, 2) and expert usage (TS3, 5). Participants were explicitly notified of the equal distance between data points for each scale of the 5-UD. After the final test scenario, participants were allowed to further explore the prototype and give overall feedback.

General results of the usability test showed 32 mistakes made by the participants across all test scenarios, which results in an overall rate of 0.49 for making a mistake in performing a

¹⁵³ For the original 5UD questionnaire used in the usability test, see Appendix B-8.3.

test scenario. Figure 4-44 shows the sum of mistakes and hints given for each test scenario. Obviously, TS3 (13 mistakes) and TS5 (9 mistakes) involved the most challenging tasks for end users. For TS3, this was in large parts due to the complexity of the task of allocating each of two participants to one of two different seminars (9 out of the 13 mistakes were made here). Participants were either completely unaware of and overwhelmed by the need to do so (especially SemP, who usually are not in charge of booking for somebody else), believed to be forced to re-login with a different login without recognizing the respective functionality, or expected this allocation to be made in the previous / subsequent interaction step (i.e., screen).

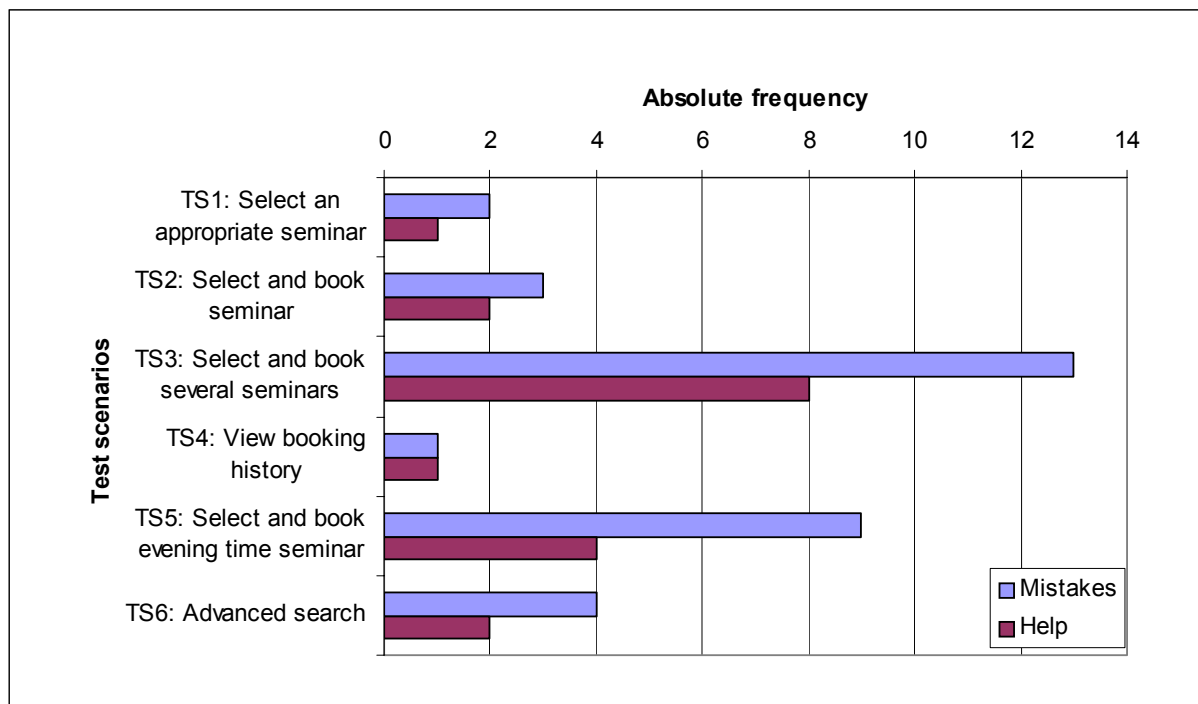


Figure 4-44: Results from the usability tests of the OSP prototype
(mistakes made by participants and help given by researcher for each test scenario)

Other, minor problems in TS3 were related to making a hotel reservation, or registering a second participant. For TS5, most problems were due to participants not being aware of the filtering mechanism that would allow them to filter all evening time seminars, or due to participants confusing an additional external link (labeled “Abendkolleg”) for the link to evening time seminars. However, even for these problematic scenarios, the lower scores for hints given compared to mistakes (TS3: 8 hints, equaling 61.5% of mistakes; TS5: 4 hints, equaling 50% of mistakes) show that participants were frequently able to solve even difficult scenarios, despite initial mistakes, on their own. This was also strengthened by comments of participants, valuing the powerful and, after one learning trail, efficient interaction mechanism. Additionally, hints given were not only due to participants making mistakes, but also due to the

limited functionality of the prototype (e.g., clicking the search-button without a search query formulated also lead to adequate search results; ignoring hotel reservation and clicking “next”, also lead to a correct hotel reservation). Thus, three out of the eight hints given for TS3 (and one of the four for TS5) do not prove that a participant really was stuck.

These results were strengthened by the analysis of participant ratings given in the 5-UD questionnaire (see Figure 4-45). Averaged across all test scenarios and participants, all of the five scales for the subjective rating of usability dimensions showed medium to strong positive values. The five maximum scores were obtained for:

- “helpfulness” in TS1 ($M = 8.64$, $SD = 0.5$) and TS2 ($M = 8.36$, $SD = 0.67$)
- “control” in TS1 ($M = 8.55$, $SD = 0.52$) and TS2 ($M = 8.27$, $SD = 0.65$)
- “efficiency” in TS1 ($M = 8.18$, $SD = 0.75$)

The five minimum scores were given to:

- “helpfulness” in TS3 ($M = 6.0$, $SD = 1.84$) and TS5 ($M = 6.82$, $SD = 2.0$)
- “efficiency” in TS6 ($M = 6.73$, $SD = 2.2$) and TS5 ($M = 6.91$, $SD = 2.2$)
- “affect” in TS3 ($M = 6.73$, $SD = 1.1$)

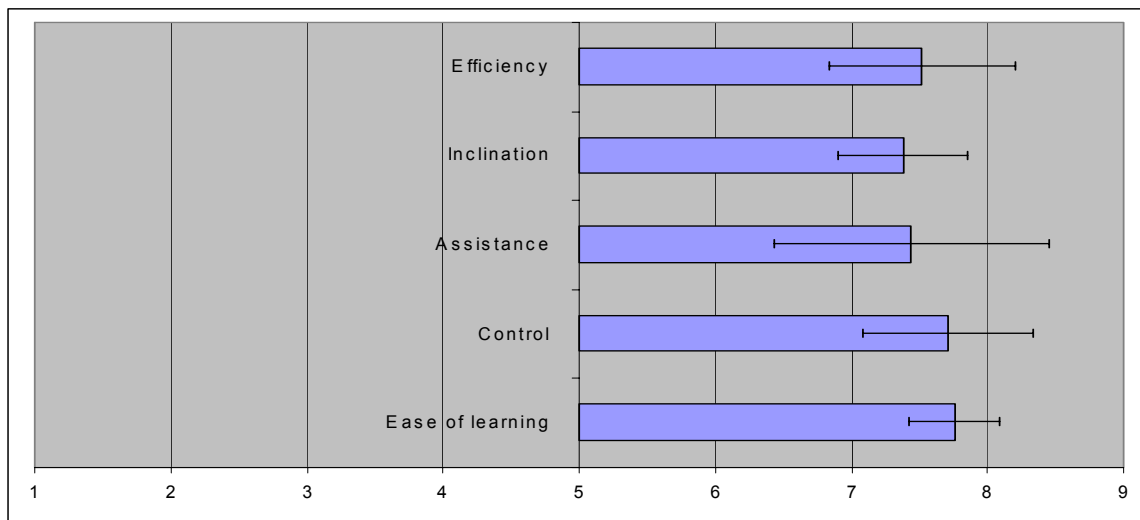


Figure 4-45: Results from the 5-UD questionnaire, across end users and test scenarios (mean values and standard deviations)

The overall strong positive scores for initial test scenarios TS1 (mean ratings across scales: $M = 8.18$, $SD = 0.78$) and TS2 ($M = 8.09$, $SD = 0.73$) proved high perceived usability for novice users performing simple tasks. Lower scores for TS3 (mean ratings across scales: $M = 6.84$, $SD = 1.4$) and TS5 ($M = 7.09$, $SD = 1.84$) again illustrated the difficulties participants experienced in these test scenarios.

The overall positive results were also corroborated by participants' comments and additional feedback. Participants especially valued the quick access to the seminar catalog on the homepage and the overall quick interaction for expert users. Participants also explicitly appreciated the self-explanatory traffic light metaphor for booking status icons, the concurrent display of content and dates / training site for each seminar, and the display of additional information for each seminar (teaching method, duration, further training route diagram) for the screens listing seminars (seminar catalog, search results page). Experienced user of the former OSP consistently judged the prototype to have a higher usability than the previous version, while at the same time providing enough consistency with it. Additional positive feedback was given on the adequateness of the seminar catalog's content structure, on task flows (for simple booking tasks and adding additional participant), and on particular functionalities (e.g., dates and training site of a seminar link to detailed information). Negative feedback was infrequent. The few complaints raised were mostly due to difficulties with the previously mentioned task flows for complex booking (allocating two different seminars to two different participants). Additional issues involved minor wording ("Abendkolleg" for external website too close to "Abendseminare") and minor visual design problems (weak contrast for headings on screens during booking).

Process Flow During Prototyping and Testing

Similar to the Design phase, Prototyping steps were brought forward, as far as possible, in order to make up for the delay. Thus, initial prototyping activities for the *OSP Prototype V0.1* (Step 4.2) and *Content Development Guide V0.1* (Step 4.1) were started on November 10 and 13, respectively, and performed fairly in parallel, insofar in accordance with the IA Process Model V0.6 (see Figure 4-46). For both prototyping steps, input was obtained mostly from the previous Design phase deliverables (Content Requirements Collection and Wireframes); however, they also yielded mutual input to each other and both drew input from and gave input to *ERD Data Modeling* and *Visual Design*. The OSP V0.1 was completed on December 2, while actual prototyping activities for the *Content Development Guide V0.1* continued until December 12. Initially, test sessions for both prototypes were planned for the same period. However, participant availability enforced the start of *Content Provider Walkthrough* session to be postponed to December 15, whereas actual *End User Usability Test* sessions were already completed on December 11. While this allowed usability test results to be accounted for in the walkthroughs, it was not possible vice versa. Compared to initial planning, Prototyping and Summative Testing activities were completed with a delay of nine workdays. For details on the flow of input between project steps, see Appendix B-8.4.

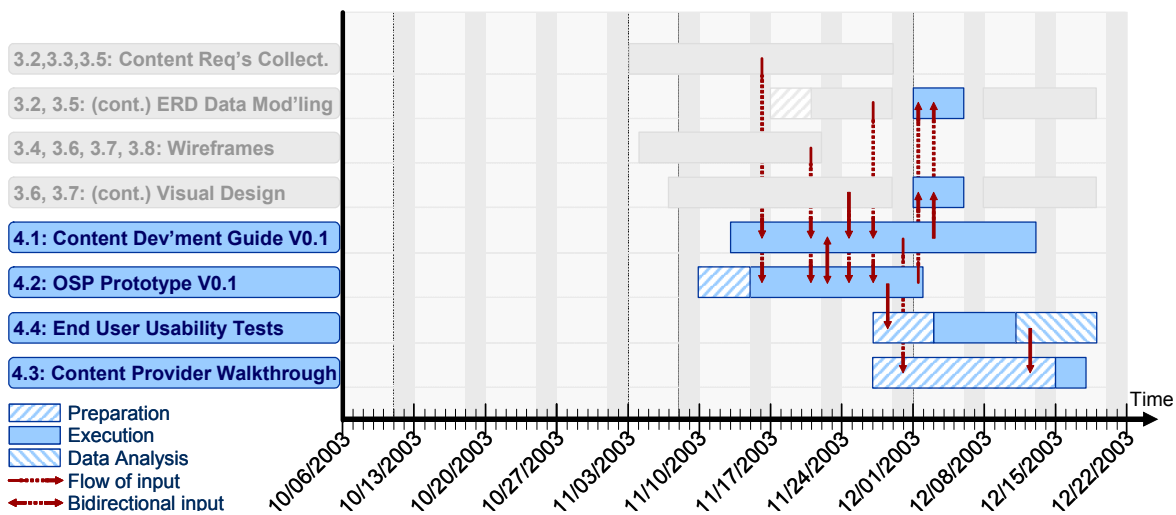


Figure 4-46: Process flow during Prototyping and Testing
(start / end of project steps and major input flows)

4.7.3.5 Validation Project Phase 5: Revision and Documentation

Methods and Deliverables

Step 5.1a: *Content Development Guide V0.2-1.0*: to revise and improve V0.1 of the guide, feedback by content providers was incorporated in V0.2-V0.9 by:

- correcting erroneous information
- adding / deleting requirements
- adjusting the level of compulsiveness of single requirements¹⁵⁴

To align the Content Development Guide with the IA Style Guide V1.0 and the OSP Prototype V1.0, it was subjected to a final revision. The resulting V1.0 of the Content Development Guide comprised 24 pages.

Step 5.1b: *OSP Prototype V0.2-1.0*: to optimize V0.1 of the prototype, results from end user usability tests were translated into V0.2-V0.9 of the OSP prototype. From the mistakes made and the issues raised by the participants, improvements to the prototype's IA system were realized by collaboration of visual designer and information architect/usability expert. To align the OSP Prototype with the Content Development Guide V1.0 and the final IA Style Guide V1.0, it was refined and adjusted to final versions of both.

Step 3.2, 3.5: (continued): *ERD Data Modeling*: to align intended adjustments and modifications of both prototypes with the constraints of the existing and not-to-be changed data

¹⁵⁴ To avoid impracticability of the guide, this involved changing a few mandatory standards to optional recommendations.

model, data modeling activities as described in the Design phase were also continued during this revision of both prototypes.

Steps 3.6, 3.7 (continued): *Visual Design*: to translate usability test and walkthrough results into the revised visual design for the OSP Prototype V0.2-1.0, visual design activities were also performed during this revision of both prototypes.

Step 5.1c: *IA Style Guide V1.0, Storyboarding*¹⁵⁵: to document the IA System and the details of the OSP prototype as a means to ensure effective and efficient implementation, a 55-page IA Style Guide was created in MS PowerPoint™ covering three major levels of documentation (see Appendix B-9.1 for the style guide's Table of Contents):

- Introduction: overall rationale, goals, constraints, and data basis for the IA redesign
- Overview on interaction flows for the OSP prototype
- Detailed specification of single screens

Interaction flows were illustrated and specified based on the generic interaction flow diagrams from the Analysis phase (see Figure 4-35, Page 175, right diagram) and the detailed interaction documentation blueprints from the Design phase (see Figure 4-38 on Page 180). For documentation of single screen designs, screenshots of the OSP Prototype V0.2 were combined with detailed annotations regarding the screen's content, layout, navigation/search, functionality, and visual design. For each test scenario used in the usability tests, every interaction step (i.e., screen) was accordingly documented, resulting in screenshot-based storyboards¹⁵⁵. Figure 4-47 shows an exemplary slide from the IA Style Guide V1.0.

¹⁵⁵ A storyboard can be defined as a sequence of annotated wireframes (see 2.1.5.4) describing a particular interaction flow (see Footnote 129 on Page 174).

OSP Design Specification
Seminar description page

Seminarsuche:
Stichwort, Kurstitel, -kürzel: **WORDF: Word für Fortgeschrittene** (1)

Seminardaten
Dauer: 2 Tage (8 h)
Beginn erster Tag 9:30h, Ende letzter Tag 16:00h
Kursform: Tagesseminar
Preis: € 510,00 zzgl. MwSt. / € 591,60 inkl. MwSt.

Zielgruppe
Anwender

Zielsetzung und Nutzen
Steigern Sie mit unserem Seminar den Nutzen, den die Textverarbeitung 'Word' Ihnen bei Ihren täglichen Aufgaben bringt.

Kursinhalte
1. Vorlagen
2. Große Dokumente
3. Dokumente gemeinsam nutzen
4. Ergänzende Programme
4.1 Rechnen
4.2 Grafiken
4.3 Organigramme
4.4 Diagramme
4.4 Formeln
4.4 Datenbanken
6. Word effektiv nutzen

Kursfolge
Voraussetzungen:
→ WORD Word Grundlagen für Anwender oder vergleichbare Kenntnisse
Weiterführende Kurse:
→ WORD-PROF Word für Profis (2)

Warenkorb
Ihr Warenkorb ist im Augenblick leer.

Termine zu diesem Seminar: (5)
In Warenkorb legen Details
12.02.-13.02.04 Essen (7)
12.02.-13.02.04 Nürnberg (8)
19.01.-20.01.04 Aalen
23.01.-24.01.04 Osnabrück
15.12.-16.12.03 Dortmund
19.01.-20.01.04 Saarbrücken
12.02.-13.02.04 Köln
23.01.-24.01.04 Augsburg
15.12.-16.12.03 Bielefeld
26.02.-27.02.04 Paderborn
23.01.-24.01.04 Ratingen
12.02.-13.02.04 Neuss
19.02.-20.02.04 Bremen
23.01.-24.01.04 Münster
07.12.-08.12.03 Wolfsburg
26.02.-27.02.04 Erlangen
In Warenkorb legen Details

Hinweise zur Terminbelegung: (6)
Ausgebucht (Warteliste mgl.)
Weniger als 40% freie Plätze
Mehr als 40% freie Plätze

Weiterbildungsweg:
Grafik, die den Zusammenhang und Ablauf von Kursen zum jeweiligen Thema grafisch veranschaulicht.

Seminar description 1/2
Logged-out

MainContent
1. Seminar description including all relevant seminar information which is valid for all dates; date-specific information under "Details" (→ 5.)
2. "Kursfolge": links to pre- and post-seminars, and to diagrams showing further training routes („Weiterbildungsweg")

SubContent – Shopping Cart:
3. Shopping cart ("Warenkorb") is displayed here, for each seminar description and subsequent pages

SubContent - Dates:
(„Termine zu diesem Seminar:")
4. Check boxes: allow for multiple selection of dates, to put into the shopping cart ("In Warenkorb legen") or display detailed information ("Details")
5. Details: PopUp-window with detailed information on particular dates and venue
6. Booking status & legend ("Hinweise zur Terminbelegung"): traffic light metaphor: green more than, yellow less than 40% bookings available, red: waiting list
7. Dates link to PopUp-window with detailed dates
8. Training venue links to detailed venue information
9. Additional functions (Print version, PDF, Send as email)

Druckversion PDF Als Email (9) ↑

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Figure 4-47: Exemplary slide from the IA Style Guide V1.0
(Design specification for a seminar description page¹⁵⁶)

Step 5.1d: *Final Results Presentation*: To hand over deliverables to the client, close the immediate project, and plan possible next steps, final results were presented to clients in a 3-hour meeting. As in the previous meetings, participants (N=4) included the project sponsor and three responsible stakeholders of the client's Content Management, Sales & Marketing, and System Development departments. Final deliverables included:

- Content Development Guide V1.0 (MS Word™-file)
- IA Style Guide V1.0 (MS PowerPoint™-file)
- OSP Prototype V1.0 (.html-files)

Based on CT IC 7's quality management policies, client stakeholders were then asked to fill in a standard Quality Management Feedback Questionnaire with 10 items covering the quality of project results, project execution, and collaboration between client and CT IC 7 (see Table 4-24 for details). Client stakeholders discussed each item in turn, with the moderator not being present, and rated each by consensus on a five-point scale. Table 4-24 shows respective results. Participants were free to note down additional comments.

¹⁵⁶ Translated from German.

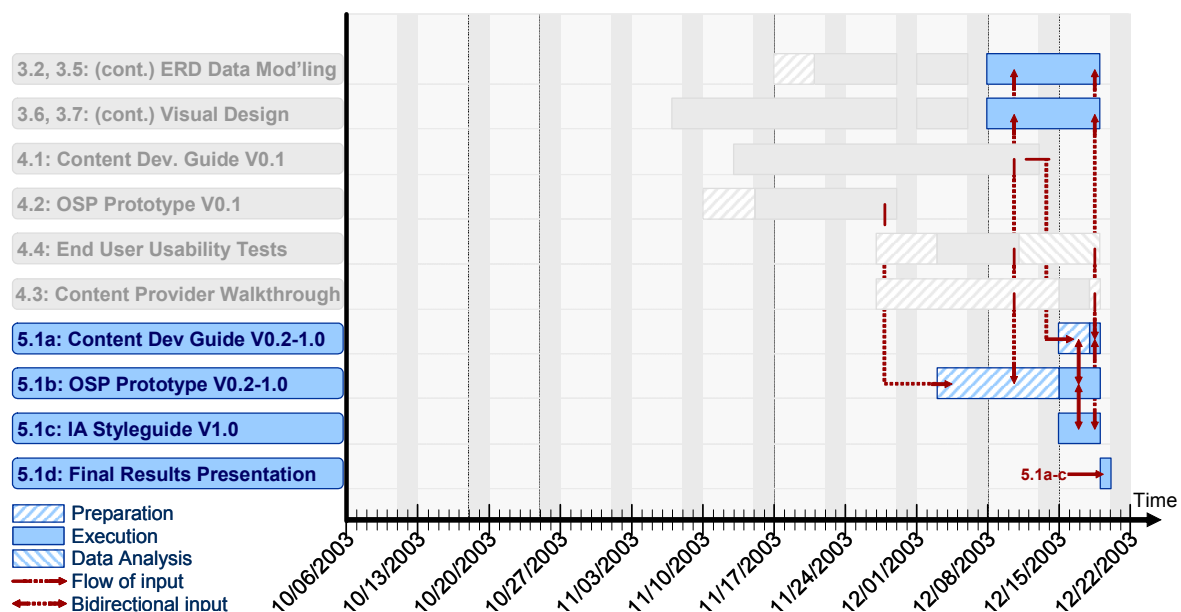
Table 4-24: Client Feedback Questionnaire ratings for the OSP project given by clients

Quality Management Feedback Questionnaire item	Client Rating				
	++	+	+/-	-	--
Project results: goal achievement	x				
Project results: adherence to delivery dates	x				
Project results: cost-benefits ratio	x				
Project results: overall quality of project results	x				
Project execution and client orientation: project management	x				
Project execution and client orientation: CT IC 7] expertise	x				
Project execution and client orientation: team communication	x				
Project execution and client orientation: project] flexibility	x				
Project execution and client orientation: transfer of results	x				
Collaboration: collaboration [between client and CT IC 7]	x				

Due to internal, planned but not yet realized reorganization and redirection of departments within the client's organizational unit triggered by the client's upper management, no immediate implementation of the IA system could be started after project closure; therefore, although further steps (supervising implementation, evaluating implemented system) were discussed, these were not scheduled for the near future.

Process Flow During Documentation

The revision of both prototypes was prepared already in parallel to respective usability test/walkthrough sessions, and finalized after these were completed (for the OSP Prototype, revision was performed from December 11–18; for the Content Development Guide on December 18; see Figure 4-48), including the alignment with *ERD Data Modeling* and *Visual Design* deliverables.

**Figure 4-48: Process flow during Documentation: start / end of project steps and major input flows**

Minor bugs of the OSP Prototype V0.1 (problems due to mere faulty technical implementation) had already been resolved in parallel to testing. All documentation deliverables were created in parallel, yielding mutual input, and subsequently presented to and handed over to client stakeholders on December 19. The project thus was completed as scheduled in the initial project planning.

4.7.4 Results Drawn From the Validation Project for the Process Model

4.7.4.1 Approach

The overall objective of conducting the validation project was to evaluate the IA Process Model V0.6 against the three key target criteria (TC) defined in 4.3.3:

- TC1: *Effectiveness* of IA process instances
- TC2: *Efficiency* of IA process instances
- TC3: *Scalability* of the IA process model

In the following, these target criteria are applied to deliverables and process characteristics of the validation project, in order to draw conclusions about the quality of the IA Process Model.

4.7.4.2 Key Target Criterion TC1: Effectiveness of IA Process Instances

The effectiveness of the process instance derived from the IA Process Model V0.6 was measured in terms of the quality of the resulting IA system. Accordingly, the target criterion TC1 was broken down into (see 4.3.3):

- TC1.1: user goal achievement > 80%
- TC1.2: business goal achievement > 80%

Both sub-target criteria were concretized in the course of the validation project. Hence, for the former, improved user goal achievement was translated to (see 4.7.3.1):

- TC1.1.1: total of errors in finding a seminar and making a reservation < 1 on average;
- TC1.1.2: end users' ratings in the 5-UD > 80% of optimum value on average¹⁵⁷

For TC1.1.1, results of end user usability tests on the OSP prototype showed an average rate of mistakes of 0.49 across all test scenarios and participants, thus outperforming the criterion by more than 50%. Computing a mean value, in this context, largely decreases the impact of

¹⁵⁷ Computed across all five dimensions of the 5-UD and across all six test scenarios in the usability test.

the few complex and error-prone test scenarios.¹⁵⁸ However, as shown in the OSP Analysis and Testing sessions, the scenarios most frequently performed by end users indeed involve rather simple tasks, while complex tasks, such as TS3, are typically only performed by registration officers. Particularly for this scenario TS3, the high “ease of learning” scores indicate a decreasing rate of mistakes. Thus, especially for registration officers, which are highly skilled in using the OSP, repeated complex bookings very likely will result in fewer errors, rather than more. In sum, therefore, target criterion TC1.1.1 has been achieved.

For TC1.1.2, the overall mean value across the five scales of the 5-UD was 7.56, which equals 84.01% of the optimum value 9. The criterion value of more than 80%, although a very ambitious one, was thus achieved. The strong and consistent character of ratings, across respondents and tasks, also reduces the risk of misinterpreting results from the 5-UD (see 2.2.6.1). Finally, the 5-UD results are also in line with and thus are confirmed by additional quantitative data on objective effectiveness and efficiency measures (rates for mistakes made, hints given), as well as qualitative data on subjective satisfaction (overall low frequency of complaints during the test). Thus, also criterion TC1.1.2 has been met.

Sub-target criterion 1.2., improved business goal achievement, involved two different business goals, being (#1) to raise proportion of online (vs. telephone-based) reservations, and (#2) to improve the OSP’s underling content management process. TC1.2 was therefore detailed during the validation project as follows:

- TC1.2.1: percentage of online reservations > current state
- TC1.2.2: content providers’ 5-UD ratings > 80% of optimum value on average¹⁵⁹

For TC1.2.1, as described above, client-internal reorganization and redirection efforts delayed and finally prevented the implementation of the redesigned IA system. It was therefore not possible to actually measure whether and if so to what degree the implemented IA system would have increased the percentage of online bookings, as compared to telephone-based bookings. However, the results of the usability tests confirmed that with the redesigned IA system, in particular previously abandoned online booking sessions, which resulted finally in and thus represented a huge part of phone-based bookings via the client’s call center, now have a higher chance to be completed, due to design flaws being eliminated and vital end user requirements being met. This was also substantiated by unisonous feedback from content pro-

¹⁵⁸ While four out of the six test scenarios resulted in fairly low error rates, only two involved significantly higher error rates (TS3, TS5)

¹⁵⁹ Computed across all five dimensions of the 5-UD.

viders and project stakeholders, which both had regular and direct contact with end users who failed at online bookings. Therefore, although no exact numerical evaluation of the criterion can be given due to the infeasibility of implementation, the criterion TC1.2.1 has been met in terms of its semantic requirements.

For TC1.2.2, the overall mean value across the five scales of the 5-UD and across all content providers was 7.47, equaling 82.96% of the optimum value 9. Thus, the criterion of more than 80% was achieved, although the target value was very ambitious. However, only three content providers participated in the walkthrough, which challenges reliability of results. Still, the results at hand again are particularly strong and consistent, and confirmed by content providers' comments during the walkthroughs, as well as by the client's content management stakeholders. Therefore, target criterion TC1.2.2 has been achieved.

In sum, the key target criterion TC1, regarding the effectiveness of the process instance, has been met. The overall effectiveness of the process instance was also corroborated by feedback of client stakeholders as given in the Quality Management Feedback Questionnaire (see Table 4-24). Maximum ratings were given for "goal achievement" and "overall quality of project results". These ratings, together with affirmative comments raised during the final results presentation and noted in the Feedback Questionnaire¹⁶⁰, confirmed client stakeholders' overall satisfaction with project results, and thus with the effectiveness of the process.

4.7.4.3 Key Target Criterion TC2: Efficiency of IA Process Instances

The efficiency of the process instance derived from the IA Process Model V0.6 was defined in 4.3.3 as the ratio of effectiveness of the process instance in relation to resources expended. The respective reference value (1/120) for the OSP project was drawn from UE / IA expert estimates, based on the individual characteristics of the project (see 4.6.3.3). Accordingly, to meet target criterion TC2, the project had to be completed successfully in terms of the concretized TC1.1 and TC1.2 (numerator) in 120 person-days (denominator) or less. Table 4-25 shows single team members and the time each spent working on the project. In sum, workforce amounted to 106.5 person-days. Combined with the results for effectiveness of the OSP process instance (numerator = 1; see above), the OSP process instance efficiency score is 1/106.5. Comparing this with the efficiency reference value of 1/120 yields:

¹⁶⁰ Example for affirmative comments of client stakeholders as noted in the Feedback Questionnaire: "the OSP prototype was appealing and convincing"

$$\frac{1}{105.5} > \frac{1}{120}$$

Thus, target criterion TC2 has been met in the validation project. This assertion of an efficient process instance is also corroborated by client stakeholder ratings and comments from the Quality Management Feedback Questionnaire. Maximum scores were given for ratings of “adherence to delivery dates”, “cost-benefits ratio”, “[project] flexibility”, and “project management” (see Table 4-24). Although the special billing agreement for the project, which warranted low costs for the client (see 4.7.2.1), might account partly for the degree of approval, these ratings, together with additional comments¹⁶¹, nevertheless strongly confirm the client’s satisfaction with how resources were spent to achieve the desired results.

Table 4-25: Team members and their time spent working for the OSP project

# of persons	Role / employee status	Activities	Time spent
1	IA / UE expert (author):	Overall IA, UE activities	53 person-days
3	UE experts (regular employees)	informal focus group in Design phase regarding detailed interaction flow	0.5 person-days (3 x 1.5 hs.)
1	UE / IA working student	Overall IA, UE activities	49 person-days ¹⁶²
1	Visual design working student	Visual Design activities	4 person-days ¹⁶²
		Sum expert person-days:	53.5
		Sum students person-days:	53
		Overall sum:	106.5 person-days

4.7.4.4 Key Target Criterion TC3: Scalability of the IA Process Model

Scalability of the IA Process Model involved the successful completion (in terms of TC1.1.1. through TC2) of a *randomly selected* project. As described in 4.7.2.1, the validation project was acquired with only a minimum of constraints necessary to ensure adequate evaluation of the IA Process Model V0.6. No preconditions were posed on either the potential client, application, or project conditions. During the active project acquisition efforts, various former clients of CT IC 7, as well as previously not serviced-for Siemens departments, and one external organization were contacted in a non-selective manner and in no particular order; out of these, the later client was only the third department contacted.¹⁶³ The project thus was indeed ac-

¹⁶¹ Example for affirmative comments of client stakeholders as noted in the Feedback Questionnaire: „Despite short project duration and minimum resources for usability studies, results [of the project] were efficient“

¹⁶² This is a liberal calculation, which sums up overall hours students were engaged in the project, including students’ time spent on being introduced to tasks or supervised.

¹⁶³ Other departments did not feel the need for redesigning their website’s IA system, did not buy in to user-centered design, or their schedules did not allow for a redesign project.

quired on a random basis; together with the successful completion of the project in terms of target criteria TC1 and TC2 as shown above, target criterion TC3 therefore was met.

4.7.4.5 Summary and Conclusion

Table 4-26 summarizes the results of the validation project with regard to the target criteria TC1 through TC3. All of the six (sub)-target criteria were met. For the available data, therefore, the IA Process Model has achieved the overall target of “ensuring effective and efficient IA process instances in variable conditions”, as described in 4.3.3.

Table 4-26: IA Process Model V0.6 target criteria scores for the OSP project

Target criterion#	Target value	Validation project score	Achieved
TC1			
TC1.1			
TC1.1.1	Ø # errors in navigating and booking < 1	0.48	Yes
TC1.1.2	Ø End user ratings > 80%	84.01%	Yes
TC1.2			
TC1.2.1	Percentage of online reservations > current state	(logically concluded)	Yes
TC1.2.2	Ø Content provider ratings > 80%	82.96%	Yes
TC2	Process instance efficiency > 1/120	1/106.5	Yes
TC3	Random project selection, TC1-TC2 successful	Random; TC1, TC 2 achieved	Yes

4.8 Step 8: Redesign of IA System and Process Model

4.8.1 Outline and Objectives

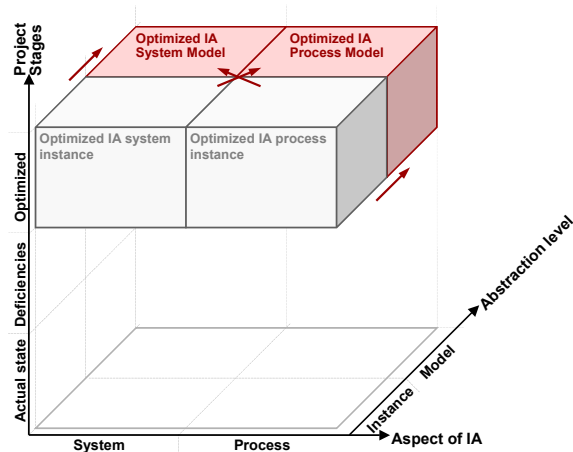


Figure 4-49: Visualization of step 8

Outline: Both the IA System and Process Model were subjected to a final revision of semantic and formal aspects, in order to integrate results from the case study, and align these with previous results.

Objectives:

(1) For the IA System Model:

- Adjust components of IA systems

(2) For the IA Process Model: Optimize

- overall process flow

- detailed process step specifications

- overall process description language

- IA Methods Catalog

4.8.2 Methods and Materials

4.8.2.1 IA Process Model V1.0

Final Revision of Process Flow Diagram and Process Step Specifications

The final revision of the overall process flow and individual process steps incorporated both V0.4 and V0.6 of the IA Process Model, as well as the results drawn from and experience gained during the validation project. In detail, input drawn included:

1. From the IA Process Model V0.4:
 - overall process flow
 - detailed specification of single process steps
2. From the IA Process Model V0.6 (and thus, from the expert workshops):
 - additional / removed / joined process steps¹⁶⁴
 - revised overall flow of input between process steps
 - embedding of semi-external process steps in respective disciplines / processes¹⁶⁵
 - revised IA Methods Catalog
3. From the validation project:
 - modified process phases¹⁶⁶

¹⁶⁴ Example: “Database Modeling” in V0.6 replaced “Define Search Thesaurus” and “Define Metadata Schemata” of V0.4.

¹⁶⁵ Example: “Database Modeling” in the discipline of Database Design / System Development; “Visual Design” in the discipline of Corporate Branding.

¹⁶⁶ Example: “Prototyping” and “Testing” separated in V0.6.

- dependencies between process steps requiring extension of steps across phases¹⁶⁷
- modified overall flow of input between process steps

A major change to V0.6 thus involved the re-grouping of V0.6's process phases "3 Design" and "4 Prototyping and Summative Testing" into V1.0's process phases "2 Design & Prototyping" and "3 Testing", in order to account for the results of previous steps, and to align the IA Process Model with CT IC 7's internal process documentation.

While integrating the results of the validation project into the high-level process flow of V0.6, it became apparent that the ARIS language did not scale very well to the complex temporal dependencies between process steps that were to be described by the IA Process Model (e.g., a process step that should be performed in parallel to two other, successive steps). As other available process description languages involved similar shortcomings, a new process description language was devised. Subsequently, the details of each process step were finalized capitalizing on the specification of process steps in V0.4.

Final Revision of the IA Methods Catalog

The IA Methods Catalog was then aligned with the modified process phases and steps. Due to the separation of prototyping and testing phase in V1.0, the ratings for method applicability in a given phase had to be adjusted accordingly. This was achieved by having participants of the previous Expert Evaluation Focus Groups re-rate the applicability of methods in question¹⁶⁸ for LUCIA Process Phases "2 Design & Prototyping" and "3 Evaluation". Re-raters included all but one (participant #6) earlier participants (see Table 4-12 and Table 4-14 for details on participants). The applicability of methods in a particular project *step* was subsequently derived from these ratings, from the descriptions of methods as given in 2.1.5, 2.2.6.1, and 4.2.3, and from the revised specifications of individual LUCIA Process Steps as described in 4.8.2.1. Contradictory data for SC1 from these three sources was resolved by balancing the weight of available input.

Methods were grouped to facilitate the use of the Methods Catalog; missing group values for SC1 through SC4 were derived by computing the median across methods pooled in this group (SC2, SC4), and by extending the rationale for SC1 and SC3. The methods "Guideline review" and "Standards inspection" were pooled due to their large overlap in methodological

¹⁶⁷ Example: "Develop Online Branding / Visual Design" and "Data Modeling" spanning across the entire Design & Prototyping phase in V0.6.

¹⁶⁸ Methods in question included methods rated in V0.2 as:

(1) applicable in both "Prototyping & Summative Testing" and "Design & Formative Testing"
 (2) applicable during "Prototyping & Summative Testing", but not applicable in "Design & Formative Testing"

focus, scope, and procedure. Ratings for the pooled method “Guideline review / Standards inspection” remained unchanged, as both showed identical ratings for all selection criteria SC1 through SC4 in V0.6, which also confirmed their close similarity.

4.8.2.2 IA System Model V1.0

The final revision of the IA System Model involved extracting from the final version of the IA Process Model the components of an information system that the process model is concerned with, and merging them with the available components of the IA System Model V0.1 through V0.4. Drawing on feedback from UE / IA experts regarding the IA System Model V0.4 obtained in the expert evaluation focus groups, and on results from the validation project regarding dependencies between information system components (and thus, regarding IA System components and their internal and external dependencies), components for the IA System Model V1.0 were re-grouped and re-labeled.

4.8.3 Results (see Chapter 5)

For a detailed description of final results, see the following Chapter 5.

5 Final Results

5.1 Definition of the Concept “Information Architecture”

From the available results, the basic concept of “Information Architecture” is defined as:

Definition: *Information Architecture* defines the organization of and the access to information.

5.2 IA System Model V1.0

5.2.1 Definition of “IA System”

Based on the definition for the basic concept, an IA system is defined as:

Definition: An *Information Architecture (IA) system* is a group of interdependent elements of an overall information system that together define the organization of and the access to information contained in this information system.

Accordingly, components of an IA system were re-defined as:

Definition: *IA system components* are the elements of an information system related to the organization of and the access to information.

5.2.2 IA System Model V1.0

The IA System Model V1.0 (see Figure 5-1) comprises six main components, which are arranged on a vertical continuum ranging from organization-focused (left) to access-focused components (right). The enumeration of components thus does not convey any hierarchy of components, but rather indicates relative emphasis of each component regarding organization vs. access. In this manner, components 1 through 3 focus on organization of information at three levels of abstraction / decomposition (starting from most abstract / decomposed), while components 4 and 5 include the two major modes of access to information in websites.

- 1 Data Model:** organization of numbers, facts, and figures into data entities with attributes and relations, which establishes context and semantic associations. Significant patterns of such organized data form information.
- 2 Content Model:** definition and organization of content type classes: description schemes for generic types of information (and functionality) to be contained in a system, including each class' metadata schema, additional formal and semantic characteristics, and relations.
- 3 Site Model:** arrangement of content objects (instances of a content type class) at an information system's inter-page (content structure) and intra-page (layout) level, and definition of end user interaction flows, which together enable end users' access to information (and use of functionality).
- 4 Navigation System:** definition of access to information by the user browsing through the system's content structure.
- 5 Search System:** definition of access to information by the user formulating a query, and the system delivering a set of results (content objects matching the query).
- 6 Labeling System:** definition of terms used to represent information (and functionality), and their systematic application.¹⁶⁹

Component 6, Labeling Systems, spans vertically across the former five components, which emphasizes the fact that labels play a major role in all of the former, be it organization- or access-focused components. For that reason, the design of labeling systems within the overall IA process cannot be assigned to a single process step, but rather is distributed across and integrated in process steps covering the design of the former five components.

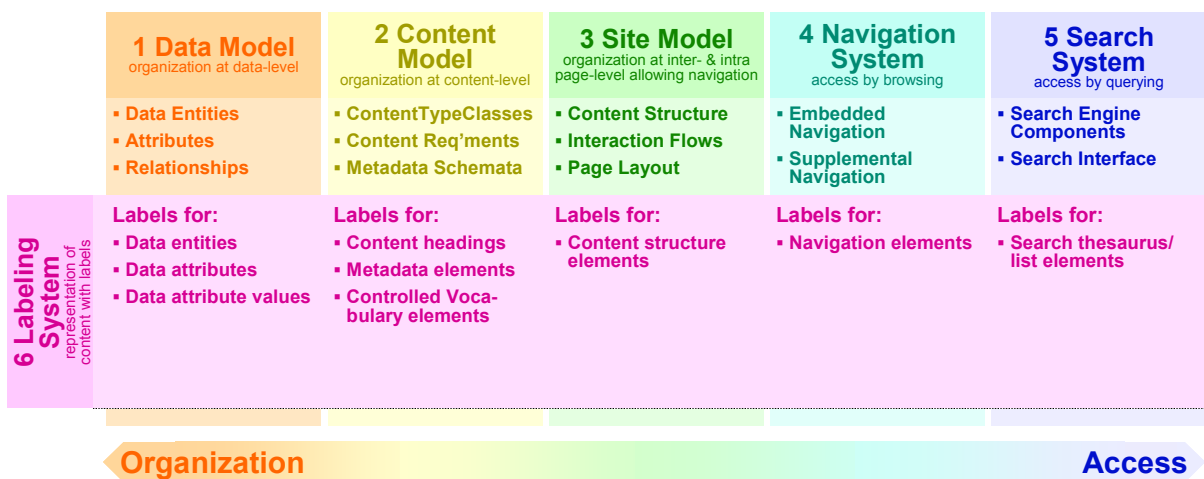


Figure 5-1: IA System Model V1.0

¹⁶⁹ Definitions are partly based on the delineations given in Albers (2003); Boiko (2002); Hagedorn (2000); Krcmar (2003); Marcus (2002); Rosenfeld & Morville (2002); Quine (2003)

5.3 LUCIA: IA Process Model V1.0

5.3.1 Definition of “IA Process”

Based on the definitions given above, an IA process is defined as follows:

Definition: An *Information Architecture (IA) process* is a series of interrelated activities defining the organization of and the access to information within an information system.

In the following, the IA Process Model V1.0 is referred to as LUCIA Process Model, which includes the (1) LUCIA Process Flow Diagram, (2) LUCIA Interdisciplinary Integration Diagrams, (3) LUCIA Process Step Specifications, the (4) LUCIA Methods Catalog, and (5) LUCIA Scaling Tools.

5.3.2 Introduction to LUCIA: Focus & Rationale of the Process Model

The immediate focus of LUCIA is on the design and redesign of IA systems for content-centric websites. However, the overall scope of the model also covers the design of functionality for the website. Given the fact that even downright functionality-centric websites do require most components of an IA system, in order to allow users to create, manipulate, and permanently store data, the process model is also very apt for designing such a website's IA system and interaction flows; if however, the focus of attention will naturally shift to interaction- and interface design issues.

In addition, the process model can also be extended to other product domains: as outlined in 2.1.2.1 and 2.1.7, the concepts of IA can easily be applied to information systems in general. Accordingly, the process model might also be applied to the development of interactive information products such as multimedia CD-ROMs, software applications, and various mobile devices, such as personal digital assistants, pocket PCs, and cell phones.

The overall rationale for LUCIA is one of integrated development of the different components of an IA system and of interdisciplinary collaboration during IA system design, whereby the information architect acts as coordinator of and interpreter between the different sub-processes and disciplines involved. The information architect is viewed as the person best equipped for this task due to the multitude of dependencies and overlaps of IA system components with other disciplines' deliverables. The IA system development thus is regarded as the core of information system development processes, where the different aspects and deliv-

erables of Content Management, Database Design / System Development, Usability Engineering, and Branding / Visual Design come together.

An IA system is viewed as having two major target audiences: end users (which use the site model, navigation- and search systems to access content) and content providers (which use the data-, content-, and site model to create content). In line with an overall user-centered approach, the concerns of both have to be accounted for by all disciplines involved in defining the organization of and the access to information. Both representative end users and content providers thus have to be involved during initial analysis and subsequent testing of the IA system; if however, the emphasis will vary depending on characteristics of the to-be developed IA system¹⁷⁰. Through concerted and aligned analysis and testing, the benefits of detailed data on end users and content providers' context of use and requirements, as well as their direct feedback on the design can be efficiently utilized by all disciplines involved.

5.3.3 LUCIA Process Phases, Process Steps, Process Flow, and Roles

5.3.3.1 Overview on LUCIA Process Phases and Process Flow

The LUCIA Process Model, as diagrammed in Figure 5-2, comprises seven distinct phases:

- 0 Discovery:** identifying the sponsoring organization's business context, site characteristics, and setting up the project; enumerated "0" because this is a preparation phase usually not paid for by the client
- 1 Analysis:** analyzing status quo of the to-be developed site and competitors, end user and content provider context of use and requirements
- 2 Design & Prototyping:** designing IA system; brand development for the site; prototyping Content Development Guide and site prototype
- 3 Testing:** evaluating Content Development Guide & site prototype
- 4 Revision & Documentation:** revising Content Development Guide & site prototype; documenting IA system & Content Development Guide
- 5 Implementation:** technically implementing the site; setting up and starting the Content Management process
- 6 Maintenance:** maintenance of content, technical issues, IA system, and brand management

The LUCIA Process Flow of input and output is visualized in Figure 5-2 with black solid arrows.

¹⁷⁰ For example, in designing an IA system for a Knowledge Management site, where any user can be both content provider and end user at the same time, efforts might be distributed 50:50 between analyzing their needs as content providers vs. end users; whereas for a small internet website with only 15 content providers, but the entire online population as potential end users, the ratio might rather be close to 10:90 or more.

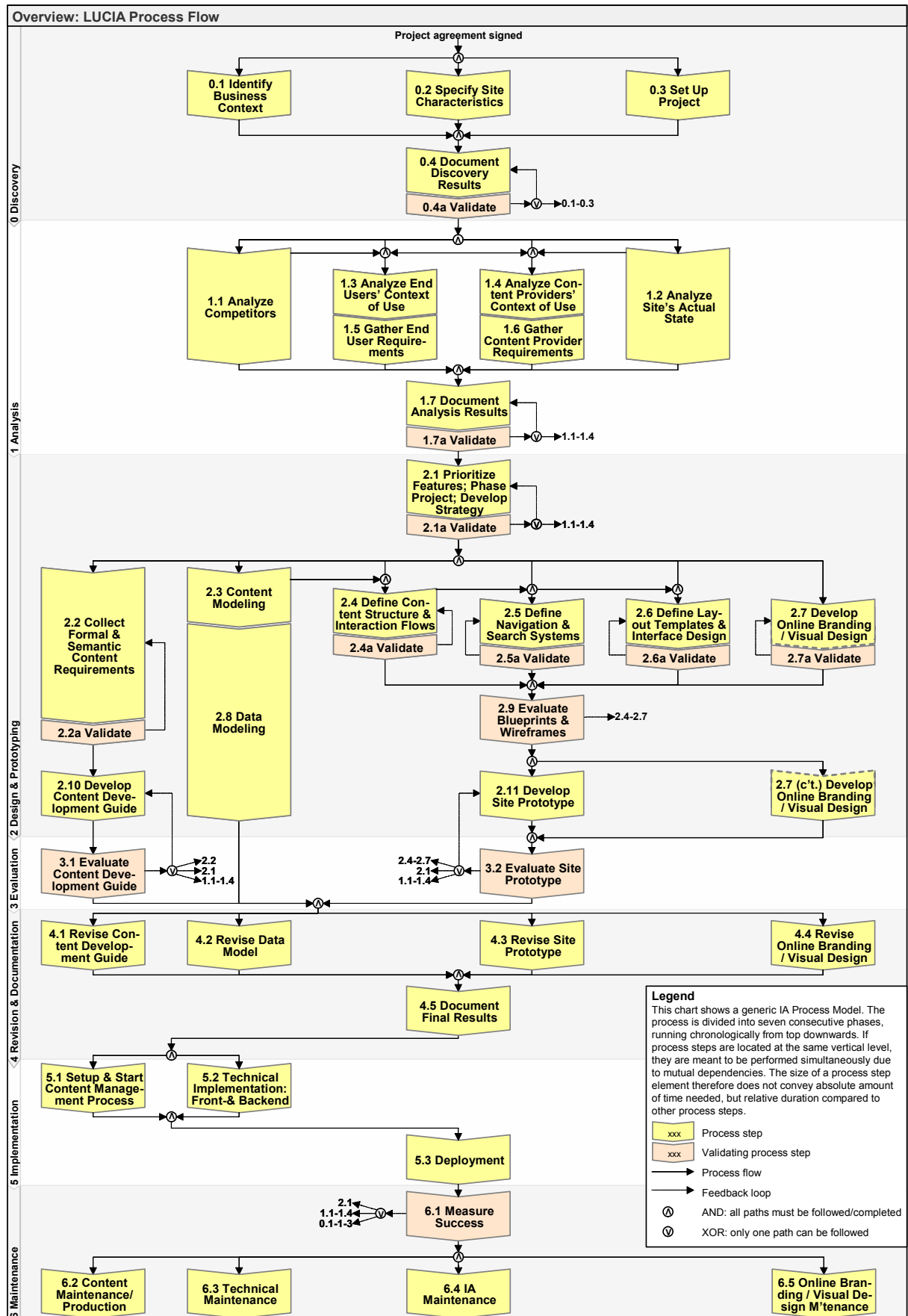


Figure 5-2: LUCIA V1.0: Process Flow Diagram

In order to enhance readability of the diagram, no arrows are used to describe the alignment¹⁷¹ of parallel process steps. These dependencies between parallel steps are illustrated implicitly through their same vertical level in the diagram, and detailed recommendations for aligning them are given in the LUCIA Process Step Specification (see below). Feedback loops are indicated in Figure 5-2 with dashed arrows; complete feedback paths are partially indicated by merely listing the process steps to which the feedback can flow back.

5.3.3.2 LUCIA Process Roles

Table 5-1 shows roles for the LUCIA Process Model. The roles were defined as to fit medium project size (for an IA system with about 500 to 1,000 individual pages, and core team size of 8 to 10); however, they can be adjusted to a given project size and individual skill sets of team members (see 5.3.5.8). The roles are described by the tasks they are responsible for or share responsibility for with other roles within the LUCIA Process Model. Tasks that a role is merely involved in, but not responsible for, are not listed in the description.

Table 5-1: LUCIA V1.0: definition of roles

Role title	Description / Responsibilities
Project sponsor	Client (contracting entity)
Project Manager	Responsible for: <ul style="list-style-type: none"> ▪ coordinating efforts of other roles involved ▪ identifying business context, site characteristics, & project setup; documenting & validating these discovery results; ▪ validating analysis results Shared responsibility for: <ul style="list-style-type: none"> ▪ prioritizing features / phasing project / developing project & IA strategy ▪ measuring success
Information Architect	Responsible for: <ul style="list-style-type: none"> ▪ collecting formal & textual content requirements ▪ content modeling ▪ defining content structure & interaction flows Shared responsibility for: <ul style="list-style-type: none"> ▪ analyzing competitors & site's actual state, end users' and content providers' context of use and requirements, and documenting these analysis results ▪ prioritizing features / phasing project / developing project & IA strategy ▪ defining navigation & search systems, layout templates & interface design ▪ data modeling & revising data model ▪ developing & revising content development guide & site prototype ▪ documenting final results ▪ IA maintenance
Content Manager	Responsible for: <ul style="list-style-type: none"> ▪ setting up & starting the Content Management process & evaluating content ▪ maintaining & producing content Shared responsibility for: <ul style="list-style-type: none"> ▪ analyzing content provider requirements ▪ documenting & validating analysis results ▪ developing & revising content development guide

¹⁷¹ Alignment of process steps, in this context, means that parallel process steps are coordinated in focus and scope, and mutually exchange preliminary results.

System Developer	<p>Responsible for:</p> <ul style="list-style-type: none"> ▪ technically implementing front- & backend & evaluate implemented system ▪ deploying & evaluating deployed system <p>Shared responsibility for:</p> <ul style="list-style-type: none"> ▪ defining navigation & search systems ▪ data modeling & revising data model ▪ developing & revising site prototype ▪ technically maintaining the system <p>Possible subroles:</p> <ul style="list-style-type: none"> ▪ Systems Analysts, Software Developers, Software Testers, System Administrators; Software Architects, Deployment Experts; Hardware & Network experts; QA staff;
Visual/UI-Designer	<p>Responsible for:</p> <ul style="list-style-type: none"> ▪ developing online branding & visual design ▪ revising online branding & visual design <p>Shared responsibility for:</p> <ul style="list-style-type: none"> ▪ validating online branding & visual design ▪ defining & validating layout templates & interface design ▪ validating revised online branding & visual design ▪ maintaining online branding & visual design
Sales/Marketing	<p>Shared responsibility for:</p> <ul style="list-style-type: none"> ▪ validating online branding & visual design ▪ validating revised online branding & visual design ▪ maintaining online branding & visual design
Usability Engineer	<p>Responsible for:</p> <ul style="list-style-type: none"> ▪ validating content structure & interaction flow ▪ validating navigation & search systems ▪ evaluating blueprints & wireframes evaluating content development guide ▪ evaluating site prototype <p>Shared responsibility for:</p> <ul style="list-style-type: none"> ▪ analyzing competitors & site's actual state, end users' and content providers' context of use and requirements, and documenting these analysis results ▪ validating layout templates & interface design ▪ validating online branding / visual design ▪ measuring success
(Content Providers)	<p>Subroles:</p> <p>Authors, source owners, editors, metators; QA staff;</p>
(End Users)	Individual interacting with the website
(Others)	Additional roles not further specified

5.3.3.3 Individual LUCIA Process Step Specifications

For each LUCIA process step, a detailed specification is given in Appendix C-1, including:

- *Description*: focus and scope of, and rationale for, the process step
- *Input*: required deliverables from other process steps, and documented knowledge
- *Alignment with*: other process steps the step parallels and thus has to be aligned with
- *Roles*: roles responsible for and involved in performing the process step
- *Methods*: applicable methods for performing the step
- *Output*: deliverables resulting from the step
- *Validation methods*: applicable methods for validating the deliverables of the step
- *Feedback loop*: process steps to which results from validation can flow back to

Figure 5-3 shows an exemplary process step specification (for step 1.7: *Document analysis results*).

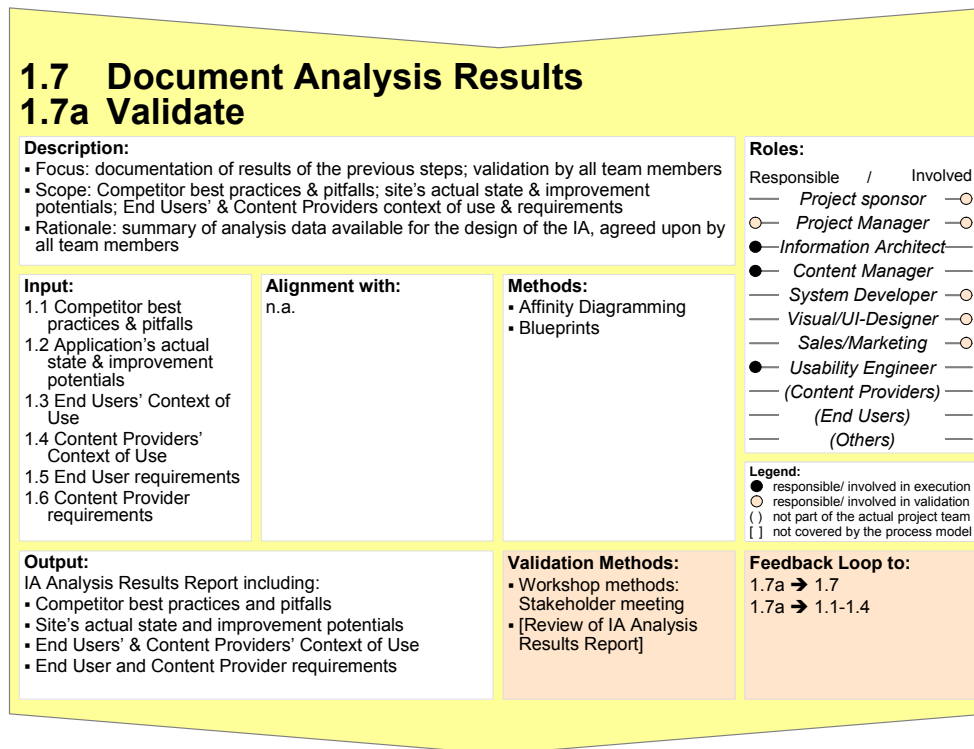


Figure 5-3: LUCIA V1.0: Process Step Specification (example)

5.3.4 LUCIA Methods Catalog

The LUCIA Methods Catalog is made up of two parts: the LUCIA Methods Selection Matrix and the LUCIA Method Description List. The catalog covers methods most commonly used in IA projects. Methods are clustered according to shared methodological focus. The catalog is not exhaustive, nor is the categorization of methods definite – it rather presents one possible taxonomy of widely used IA / UCD methods. Table 5-2 shows the Methods Selection Matrix. For each method, the matrix yields data regarding four selection criteria:

- SC1: The *process phases* each method is applicable to
- SC2: The *amount of resources* needed to conduct the method (in terms of workforce)
- SC3: Whether or not direct *user participation* is necessary to conduct the method
- SC4: The *level of UCD expertise* necessary for the researcher to conduct it properly

Within columns for SC1, each dark grey column of Table 5-2 shows expert ratings of method applicability in a particular process *phase*, while white columns indicate applicability in a particular process *step*. Lightly grey *rows* indicate a major method, while white rows include methods categorized as instances of a major method category. The LUCIA Method Descrip-

tion List given in Appendix C-2 and Appendix C-3 includes brief descriptions of each method's focus and overall procedure, as well as their individual benefits and potential shortcomings.

5.3.5 Scalability of the Process Model

5.3.5.1 Overview

As described in 3.3 and 4.3.3, the third major target criterion for the process model was defined as its scalability in terms of allowing for individual process instances derived from it to be tailored in focus and scope to individual project constraints. The IA Process Model V1.0 yields seven tools to scale the given process model:

1. Scaling the overall process flow: skipping a process phase
2. Scaling the overall process flow: skipping a process step
3. Scaling the overall process flow: bringing forward a process step
4. Scaling individual process steps: adjusting the scope of a process step
5. Scaling individual process steps: selecting an adequate method for a process step
6. Scaling individual process steps: adjusting the scope of a method
7. Scaling roles: adjusting the allocation of responsibilities to individuals

In this order, these tools describe an adequate procedure of adjusting the IA Process Model in seven steps to the constraints of a given project, ranging from changes to the overall process flow to the details of how and by whom a particular method for a single process step is conducted. In the following, these tools are further explained and the level of scalability is defined. To each adjustment, one of three levels of scalability is assigned:

Level of scalability (SL) for each scaling tool of LUCIA:

SL1 (+) Tool is recommended for certain project conditions

SL2 (+/-) Tool is possible if necessary, but not recommended (threatens quality of results)

SL3 (-) Tool is not possible without serious impairment of results quality

5.3.5.2 Scaling the Overall Process Flow: Skipping a Process Phase

For most phases of the IA Process Model, execution is mandatory. Skipping an entire process phase will almost inevitably cause serious damage to the quality of the resulting site, as described in Table 5-3. In the validation project (see 4.7), no process phase was skipped.

Table 5-3: LUCIA V1.0, Scaling Tool 1: skipping process phases

Phase to be skipped	SL	Necessary conditions (✓) / possible threats (✗)
0 Discovery	–	✗ no agreed-upon starting point for project
1 Analysis	–	✗ no data basis and focus for design efforts
2 Design & Prototyping	–	✗ implementation without design/prototyping: unstructured & thus inefficient, error-prone system development
3 Evaluation	–	✗ increased technical & design flaws, usability problems; impair-

		ing site success & thus business goal achievement
4 Revision & Documentation	+/-	✓ no serious changes have to be made after testing CDG and site prototype AND already available deliverables are sufficient for implementation / maintenance (e.g., because the IA is part of the implementation team) ✗ no explicit documentation: inconsistent / deficient implementation, suboptimal maintenance
5 Implementation	–	✗ (no running system)
6 Maintenance	–	✗ deteriorating content / IA / visual appearance; technical bugs, suboptimal performance

5.3.5.3 Scaling the Overall Process Flow: Skipping a Process Step

In certain circumstances, individual process steps might be skipped within the overall process flow. Table 5-4 shows, for each process step, level of scalability, necessary conditions, and possible threats to results quality.

Table 5-4: LUCIA V1.0, Scaling Tool 2: skipping process steps

Process step to be skipped	SL	Necessary conditions (✓) / possible threats (✗)
0.1 Identify Business Context	–	✗ business context not accounted for, IA not aimed at support of business goal achievement
0.2 Specify Site Characteristics	–	✗ basic data regarding site characteristics not available
0.3 Set Up Project	–	✗ ineffective, inefficient project process
0.4 Document Discovery Results	–	✗ no documented starting point for the project
0.4b Validate	–	✗ no explicit consensus on project constraints and setup
1.1 Analyze Competitors	+/-	✓ consciously starting from scratch without being constrained by existing competitors' solutions ✓ no competitors available (e.g., for intranet websites) ✗ competitor's mistakes repeated, competitive advantages not identified
1.2 Analyze Site's Actual State	+/-	✓ consciously starting from scratch without being constrained by existing site ✓ no existing site available ✗ mistakes repeated, constraints not accounted for; doubled efforts
1.3 Analyze End Users' Context of Use	+	✓ Conjoint execution with 1.5
1.4 Analyze Content Providers' Context of Use	+	✓ Conjoint execution with 1.6
1.5 Gather End User Requirements	+	✓ Conjoint execution with 1.3
1.6 Gather Content Provider Requirements	+	✓ Conjoint execution with 1.4
1.7 Document Analysis Results	–	✗ no data basis & documented starting point for design
1.7b Validate	–	✗ no explicit consensus on data basis & starting point for design
2.1 Prioritize Features; Phase Project; Develop Strategy	–	✗ ineffective, inefficient project process
2.1b Validate	–	✗ no explicit consensus on design strategy
2.2 Collect Formal & Textual Content Requirements	–	✗ content requirements not documented, suboptimal content
2.2b Validate	+	✓ sufficient validation of content requirements with content providers in 3.1
2.3 Content Modeling	+	✓ sufficient collaboration of information architect and system developer on metadata in 2.8 ✓ sufficient content modeling in 2.4

2.4 Define Content Structure & Interaction Flows	–	✗ insufficient, suboptimal inter-page level IA design, suboptimal data basis for 2.5-2.7
2.4b Validate	+	✓ comprehensive evaluation of blueprints & wireframes with end users in 2.9 OR 3.2
2.5 Define Navigation & Search Systems	–	✗ suboptimal navigation & search mechanisms
2.5b Validate	+	✓ comprehensive evaluation of blueprints & wireframes with end users in 2.9 OR 3.2
2.6 Define Layout Templates & Interface Design	–	✗ insufficient, suboptimal intra-page level IA design
2.6b Validate	+	✓ comprehensive evaluation of blueprints & wireframes with end users in 2.9 OR 3.2
2.7 Develop Online Branding / Visual Design	–	✗ insufficient, suboptimal online branding; no alignment of overall branding & site visual design
2.7b Validate	+	✓ comprehensive evaluation of blueprints & wireframes with end users in 2.9 OR 3.2
2.8 Data Modeling	–	✗ insufficient, suboptimal database design; no alignment of database & IA design possible
2.9 Evaluate Blueprints & Wireframes	+	✓ sufficient evaluation of blueprints & wireframes with end users in 2.4-2.7 OR 3.2
2.10 Develop Content Development Guide	–	✗ inefficient Content Management process, suboptimal content
2.11 Develop Site Prototype	+	✓ no prototype evaluation (3.2) planned
3.1 Evaluate Content Development Guide	+/-	✓ sufficient evaluation of content requirements in with content providers in 2.2b ✗ practicability & acceptance of Content Development Guide as such not tested
3.2 Evaluate Site Prototype	+	✓ sufficient evaluation of blueprints & wireframes with end users in 2.4-2.7 OR 2.9
4.1 Revise Content Development Guide	–	✗ feedback of content providers and end users not incorporated; no alignment with 4.2-4.4
4.2 Revise Data Model	–	✗ feedback of content providers and end users not incorporated; no alignment with 4.1, 4.3, 4.4
4.3 Revise Site Prototype	–	✗ feedback of content providers and end users not incorporated; no alignment with 4.1-4.2, 4.4
4.4 Revise Online Branding / Visual Design	–	✗ feedback of content providers and end users not incorporated; no alignment with 4.1-4.3
4.5 Document Final Results	+/-	✓ already available deliverables are sufficient for implementation / maintenance (e.g., because the IA is part of the implementation team) ✗ no explicit documentation: inconsistent / deficient implementation, suboptimal maintenance
5.1 Content Production	–	✗ (no content)
5.2 Technical Implementation	–	✗ (no system)
5.3 Deployment	–	✗ (no running system)
6.1 Measure Success	–	✗ no control on project goal achievement, flaws not identified, suboptimal site, no data basis for targeted maintenance
6.2 Content Maintenance / Production	–	✗ suboptimal (outdated, incorrect) content
6.3 Technical Maintenance	–	✗ technical flaws, suboptimal performance
6.4 IA Maintenance	–	✗ suboptimal IA
6.5 Visual Design Maintenance	–	✗ suboptimal visual appearance

In the validation project (see 4.7), process steps successfully skipped included:

- 1.3/1.5, and 1.4/1.6, which each were performed conjointly in the Consolidated Assessment sessions (thus not really skipped, but joined)

- 2.3, which was implicitly performed in 2.8 and 2.4
- 2.9, due to an comprehensive evaluation of blueprints & wireframes in 3.2

5.3.5.4 Scaling the Overall Process Flow: Bringing Forward a Process Step

For selected process steps, it is possible to bring them forward within the overall process flow and perform them in parallel to steps actually defined as precursors in the IA Process Model. Table 5-5 gives details on how much an individual step can be brought forward, the respective scalability level, necessary conditions, and possible threats.

Table 5-5: LUCIA V1.0, Scaling Tool 3: bringing forward process steps

Process step to be brought forward...	...& then performed in parallel to:	SL	Necessary conditions (✓) / possible threats (✗)
1.1 Analyze Competitors	0.1-0.4	+	✓ method chosen does not require detailed discovery results (e.g., content inventory, usability inspection)
1.4 Analyze Content Providers' Context of Use	0.1-0.4	+	✓ method chosen does not require detailed discovery results (e.g., content inventory, usability inspection)
2.2-2.7	1.7	+	✓ steps brought forward are not dependent on (1) explicit documentation of analysis results (e.g., because one person is responsible both for analysis and design) nor (2) results from 2.1 regarding IA strategy (e.g., because only basic issues are addressed)
2.10 Develop Content Development Guide	2.2	+	✓ 2.2b skipped AND 3.1 not skipped AND 2.10 additionally aligned with 2.2-2.7
2.11 Develop Site Prototype	2.4-2.7	+	✓ 2.9 skipped AND 3.2 not skipped AND 2.11 additionally aligned with 2.2-2.6

In the validation project (see 4.7), process steps successfully brought forward included:

- 1.1 and 1.4, because methods chosen did not require detailed discovery results
- 2.2-2.7, as far as they covered only basic design activities and did not require detailed IA strategy decisions
- 2.11, as 2.9 was skipped and comprehensive testing was performed afterwards

5.3.5.5 Scaling Individual Process Steps: Adjusting the Scope of a Step

For selected process steps, adjustments can be made regarding the scope of activities performed in these process steps. The respective adjustments are independent of the particular method subsequently chosen to carry out the step.

Table 5-6: LUCIA V1.0, Scaling Tool 4: adjusting scope of process steps

Process step	SL	Adjustments possible
1.1 Analyze Competitors	+	# of competitors analyzed
1.3 Analyze End Users' Context of Use	+	# of tasks analyzed

1.4 Analyze Content Providers' Context of Use	+	# of tasks analyzed
1.5 Gather End User requirements	+	# of tasks requirements are gathered for
1.6 Gather Content Provider requirements	+	# of tasks requirements are gathered for
2.3 Content Modeling	+	Explicit design of metadata schemata (yes/no)
2.4 Define Content Structure & Interaction Flows	+	# of possible interaction flows diagrammed with interaction blueprints
2.6 Define Layout Templates & Interface Design	+	# of templates created
2.7 Develop Online Branding / Visual Design	+	# of templates created
2.8 Data Modeling	+	Changes to an existing data model out of scope for the project ➔ data modeling activities restricted to continued alignment of IA deliverables with data model
2.9 Evaluate Blueprints & Wireframes	+	# of tasks evaluated
3.1 Evaluate Content Development Guide	+	# of tasks evaluated
3.2 Evaluate Site Prototype	+	# of tasks evaluated
4.3 Revise Site Prototype	+	Revision of blueprints and wireframes only (especially if no site prototype was created in 2.11)
4.5 Document Final Results	+	Level of detail in IA Style Guide: dependent on (1) project setup characteristics, (2) prototype level of fidelity, and (3) degree of involvement of the information architect in 5.2

In the validation project (see 4.7), the scope of process steps successfully adjusted included:

- 1.1: # of competitors adjusted to project constraints
- 2.3: no explicit design of a metadata schema; implicitly performed in 2.8 and 2.10
- 2.4: # of task flows adjusted to project constraints
- 2.6, 2.7: # of templates adjusted to project constraints
- 2.8: as no changes could be made to the existing data model, data modeling activities were restricted to continued alignment of IA deliverables with the data model
- 1.3-1.6, 3.1, 3.2: # of tasks adjusted to constraints of the sessions with end users and content providers
- 4.5: fully interactive prototype, which sufficiently documented details of the OSP functionality, allowed for merely high-level documentation in the IA Style Guide

5.3.5.6 Scaling Individual Process Steps: Selecting a Method

Using the IA Methods Catalog, a method can be selected for each process step that fits the given project constraints, according to four selection criteria:

- SC1: The *process phase / step* each method is applicable to
- SC2: The *amount of resources* needed to conduct the method (in terms of manpower)
- SC3: Whether or not direct *user participation* is necessary to conduct the method
- SC4: The *level of UCD expertise* necessary for the researcher to conduct it properly

(See 5.3.4 for the final version 1.0 of the IA Methods Catalog.)

In the validation project (see 4.7), methods for each process step were chosen deliberately; thus, for example in steps 1.3/1.5 and 1.4/1.6, the Consolidated Assessment method was applied, as it required fewer resources than other methods to achieve the desired outcome.

5.3.5.7 Scaling Individual Process Steps: Adjusting Individual Methods

Most methods included in the IA Methods Catalog are scalable in terms of variants of the basic technique. For the most commonly applied methods in IA processes, variants and respective scaling techniques have already been described in 2.1.5, 2.2.6.1, and 4.2.3 (e.g., scaling a content inventory in terms of depth / breadth; scaling a prototype in terms of level of fidelity, interactivity, and medium). A comprehensive specification of scaling techniques for each method listed in the IA Methods Catalog was not within the scope of this thesis. For further details, please refer to the literature on IA and UCD methods listed in 2.1.5, 2.2.6.1, and 4.2.3.

In the validation project (see 4.7), each method applied was adjusted to the constraints at hand. Thus, for example, usability testing of the OSP prototype was deliberately kept low in terms of formalization (e.g., it was performed at the participant's workplace, not in a usability lab, and no video or audio recording was used).

5.3.5.8 Scaling Roles: Adjusting Allocation of Responsibilities to Individuals

As described in 5.3.3.2, roles for the IA Process Model were defined as to fit medium project size; however, roles can be adjusted to individual project constraints by:

1. Combining responsibilities for small projects: e.g., responsibilities of project manager, information architect, and usability engineer might be carried out by the same person
2. Distributing responsibilities for large projects: e.g., responsibilities of an information architect might be split and distributed across several persons:
 - content analyst: collecting formal & textual content requirements
 - metadata schema developer: content modeling
 - content architect: defining content structure
 - interaction designer: defining interaction flows

The detailed list of responsibilities in 5.3.3.2, together with the specification of responsible roles for each process step (see 5.3.3.3), allows for free allocation of responsibilities to individuals; however, extreme allocations, such as too many responsibilities for one individual or

spread of responsibilities across too many individuals, hold the risk of ineffective and inefficient processes (see 2.3.3). In the case study, responsibilities were combined as described in 1., allocating the roles of information architect, usability engineer, and project manager to one person (see 4.7.2.2).

5.3.5.9 Example for a Scaled Process Instance: Validation Project Process

Figure 5-4 shows an example for a downscaled process instance. The chart shows the process instance employed in the validation project described in 4.7. For each process step, methods as applied in the project are listed. Grayed-out process steps of the IA Process Model were skipped in the validation project.

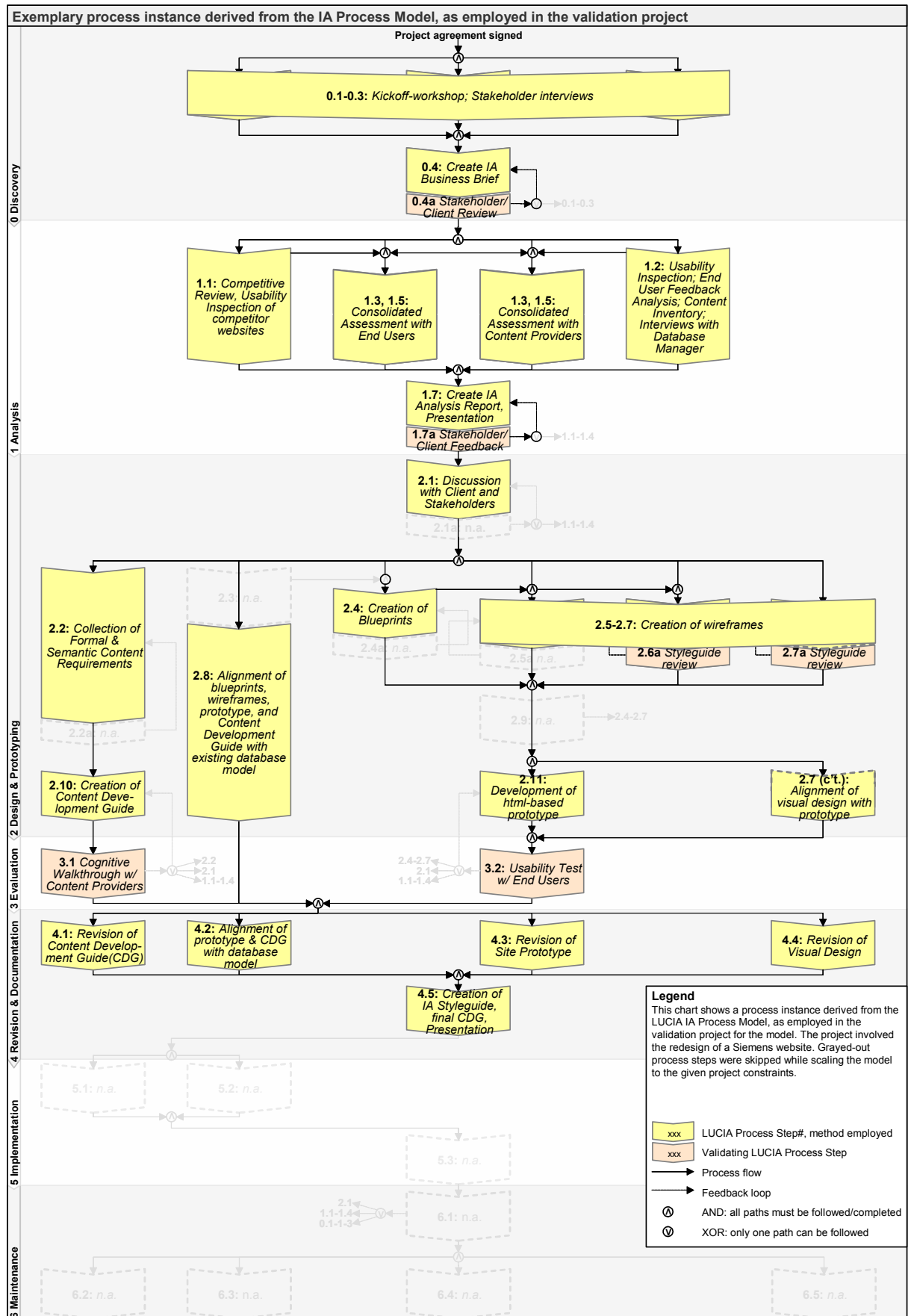


Figure 5-4: LUCIA V1.0: exemplary scaled-down process instance, as employed in the validation project

5.3.6 Connections to Other Disciplines / Processes

5.3.6.1 Introduction

In the following, connections of the LUCIA Process Model to related processes and disciplines are outlined, in order to clarify the comprehensive, multidisciplinary character of LUCIA and facilitate interdisciplinary collaboration. For each of four disciplines (Database Design, Usability Engineering, Corporate Branding, and Content Management), both an *Interdisciplinary Integration Diagram* and a matrix with respective connections are given.

Each Interdisciplinary Integration Diagram is basically a modified LUCIA Process Flow Diagram, but one which only highlights the steps of the paralleling discipline's traditional process that are covered by the LUCIA Process Model. Each overview diagram additionally shows a vertical pane that circumscribes core tasks for the respective paralleling discipline. A step or task of a paralleling discipline is said to be *covered by LUCIA* if the description of a given LUCIA Process Step comprises this process step in focus, scope, and methods, and integrates its flow of input and output in the overall LUCIA Process Flow. The process descriptions of the paralleling disciplines each are taken from the literature as outlined in Chapters 2.2.4, 2.2.5, 2.2.6, and 2.2.7, respectively.

In order to explain in depth what and how activities of the paralleling disciplines are covered by LUCIA, individual process steps and detailed tasks of those disciplines are additionally listed together with the respective LUCIA Process Steps in a matrix.

5.3.6.2 LUCIA and Content Management

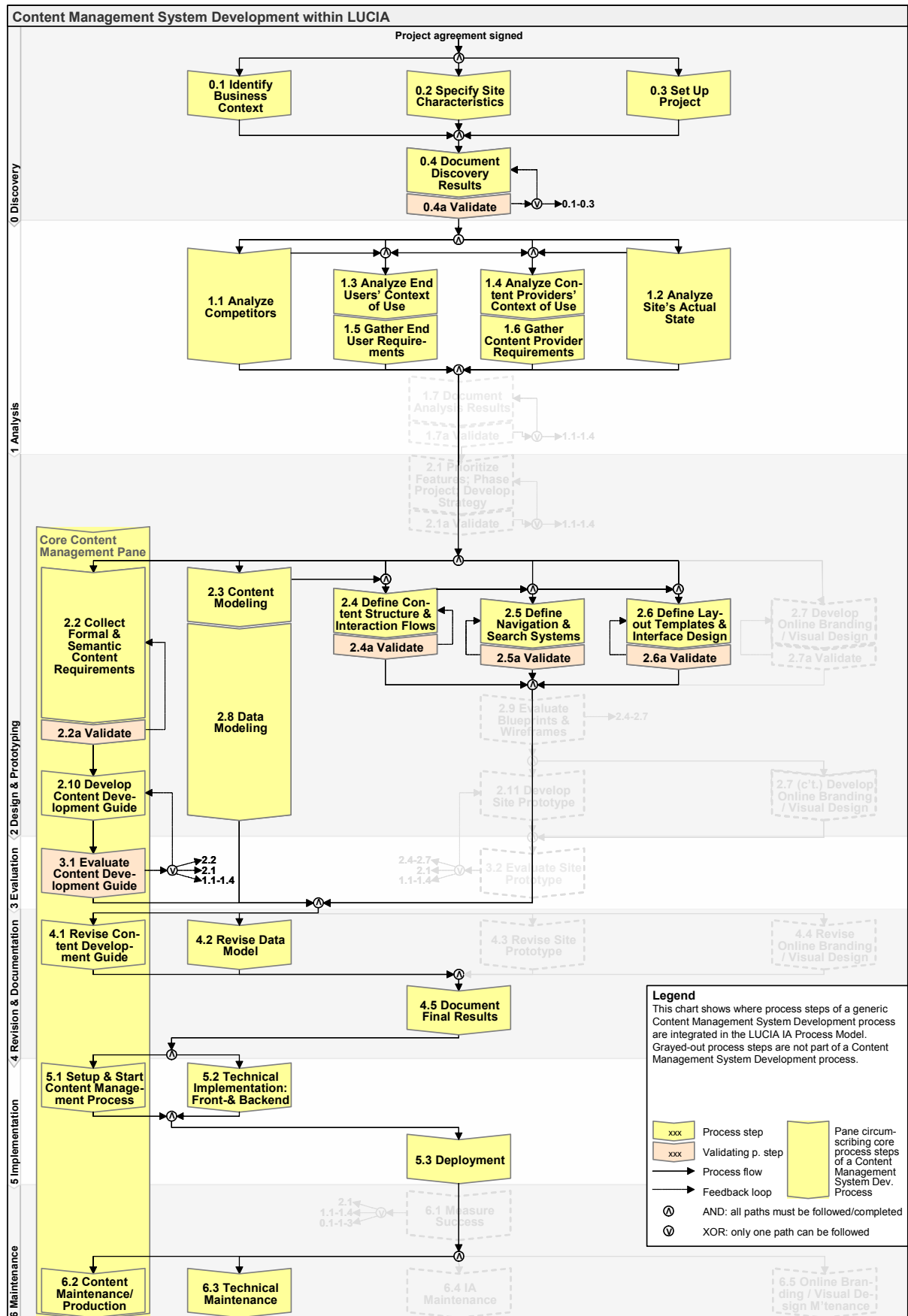


Figure 5-5: LUCIA V1.0: Interdisciplinary Integration Diagram for Content Management

Table 5-7: LUCIA V1.0: Content Management process steps covered by LUCIA

CMS implementation process steps / tasks...^a	...are covered in LUCIA in step(s):
1. Business Justification	
a. Assess readiness	
▪ identifying existing project mandate, targeted audiences, planned publications, and required content / system	0.1-0.2
b. Get a project mandate	
▪ building a consensus regarding these issues and the project mandate	0.1-0.4
2. Requirements Gathering	
a. Gather Requirements	
i. Content Requirements	
▪ kinds of content to be managed	0.2; 1.1-1.6; 2.2
▪ how it must be gathered & organized	1.1-1.6 (only from content providers)
ii. Publication requirements (the kinds and structure of outputs of the CMS)	1.1-1.6
iii. CMS requirements (how the CMS hardware and software are required to operate)	1.4; 1.6 (only from content providers)
b. Do logical design	
i. Audience analysis: specifying the target audiences for the publications	0.2; 1.3; 1.5
ii. Publication design: specifying	
▪ content and navigation for each publication	0.2; 2.3-2.5
▪ how each publication is automatically built (using templates)	2.6
▪ how each publication is personalized by the CMS	-
iii. Component design: specifying the complete set of content components to be managed and how each will be constructed	2.3; 2.8; 4.2
iv. Author analysis	
▪ specifying content authors needed and	0.2; 1.4; 1.6
▪ how the CMS will serve them	-
v. Source analysis:	
▪ specifying from where to acquire information needed for publications and	-
▪ how it will be processed to make it ready for the CMS	2.10; 3.1; 4.1; 5.1
vi. Access structure design: Specifying hierarchies and other access structures to keep content organized in its repository and to produce the navigation in publications	2.4 (publications) 2.8 (database)
3. Design	
a. Select hardware & software for the CMS	5.2
b. Plan implementation	5.2
4. Implementation	
a. Implement the system	
i. Prepare system specifications	4.5; 5.2
ii. Install and configuring the system	5.2
iii. Code templates & applications	5.2
iv. Integrate the CMS with other systems	5.2
v. Test the system & publications	5.2
b. Process content	
i. Develop a content inventory anda content processing specification	1.2 5.1
ii. Acquire & aggregate content	5.1
iii. Convert format and structure of existing content into the format and structure needed for the CMS	5.1
5. Deployment	
a. Load and test content & publications	5.1-5.3; 3.2
b. Deploy the CMS: install and test the CMS in its production environment	5.2
6. Maintenance	

a. Train Staff (including generic training on content management, localization & CMS deployment; specific training for authors, content processors, CMS administrators, page and page template developers)	-
b. Perform Maintenance: technical administration of the CMS and content maintenance	6.2-6.3

^a Content Management System development process steps according to Boiko, 2002; Galano, 2000; Schaeffer, 2001; Warren, 2001; Widerberg, 2003; see 2.2.7.1 for details.

5.3.6.3 LUCIA and Database Design

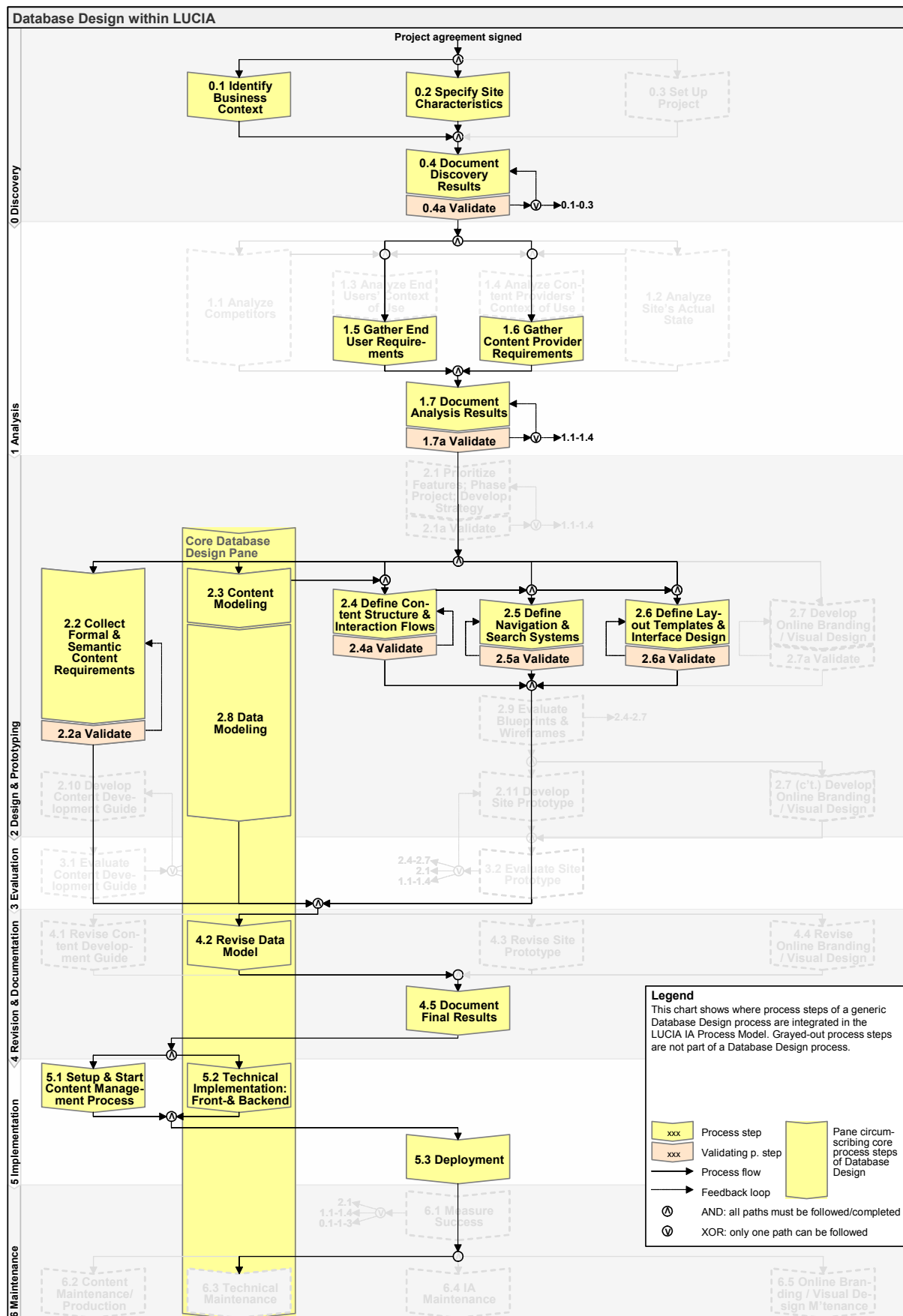


Figure 5-6: LUCIA 1.0: Interdisciplinary Integration Diagram for Database Design

Table 5-8: LUCIA V1.0: Database Design process steps covered by LUCIA

Database Design / System Development steps / tasks...^a	...are covered in LUCIA in step(s):
1. Planning and analysis	
▪ capturing business needs, including all data, processes, and rules that comprise a business	0.1; 2.3; 2.8
▪ determining what information is needed, who will deliver it, who will need it	0.2; 2.2
▪ addressing needs of application users	1.5
▪ addressing needs of system users	1.6
2. Conceptual design	
▪ documenting the business model	0.2; 0.4; 1.7; 2.3; 2.8
▪ documenting the process model	0.2; 0.4; 1.7; 2.8
3. Logical design	
▪ defining entities in more detail by adding attributes, defining different properties of each attribute, and refining relationships	2.3; 2.8
▪ employing process models to determine how end users access the database	2.4
▪ further defining end user access by prototyping views and query forms	2.5; 2.6
4. Physical design (including data normalization)	
▪ logical model is converted into a physical database structure, database is normalized	2.8, 4.2
▪ Views, access paths, and query forms are created to enable end user access	2.8, 4.2
5. Implementation	
▪ documenting the database	4.5
▪ building the database	5.2
▪ preparing data	5.1
▪ testing end user application with real data	5.2-5.3
▪ porting the database into its production environment	5.3

^a Database Design / System Development process steps according to Stephens & Plew, 2001; Stickel, 1991; for details, see 2.2.5.1.

5.3.6.4 LUCIA and Usability Engineering

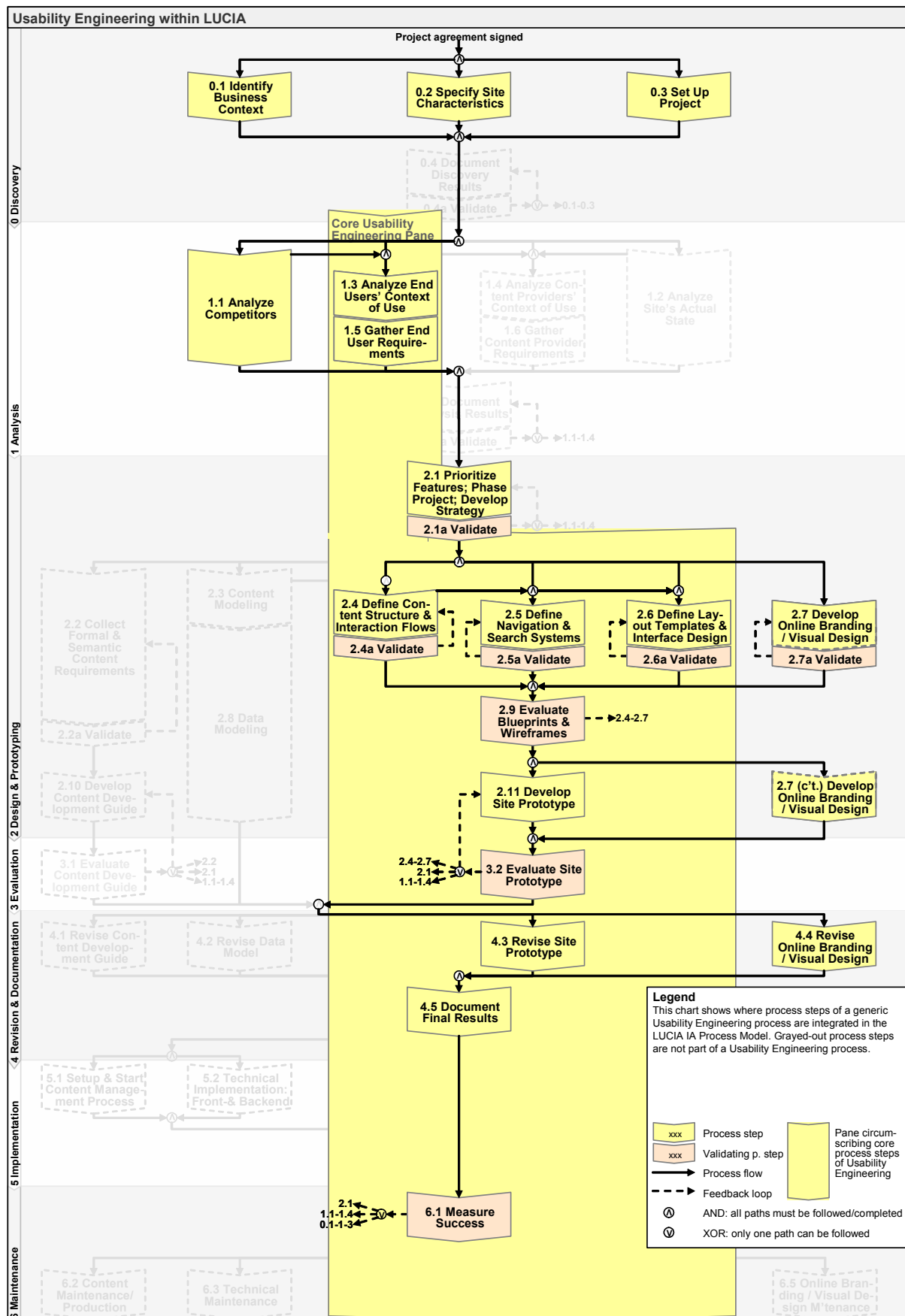


Figure 5-7: LUCIA 1.0: Interdisciplinary Integration Diagram for Usability Engineering

Table 5-9: LUCIA V1.0: Usability Engineering process steps covered by LUCIA

Usability Engineering process steps / tasks...^a	...are covered in LUCIA in step(s):
1. Project setup	
a. Define project budget & project plan	0.3
b. Set up usability team	0.3
c. Define overall product concept	0.2
2. Analysis	
a. Define business & usability goals	0.1; 0.3; 2.1
b. Identify technical capabilities & constraints	0.2;
c. Define user profiles & perform task analysis	0.2, 1.3, 1.5
d. Gather user requirements	0.2, 1.3, 1.5
e. Competitive analysis	1.1
3. Design, prototyping, testing, iterative refinement	
a. Conceptual design, formative evaluation, & iterative refinement	2.4-2.7, 2.9
b. Prototyping, formative evaluation, & iterative refinement	2.11; 3.2; 4.3; 4.4
c. Summative evaluation	3.2
d. Document deliverables	4.5
4. Implementation	
a. Develop manual / tutorial	-
b. Ensure product training & support	-
5. Maintenance	
a. Analyze user feedback	6.1
b. Benchmarking	6.1

^a Usability Engineering process steps according to Beyer & Holtzblatt, 1998; Liu, 1999; Mayhew, 1999; Nielsen, 1993; Rosson & Carroll 2002; Shneiderman, 1998; Wixon & Wilson, 1997, for details, see 2.2.6.1.

5.3.6.5 LUCIA and Corporate Branding

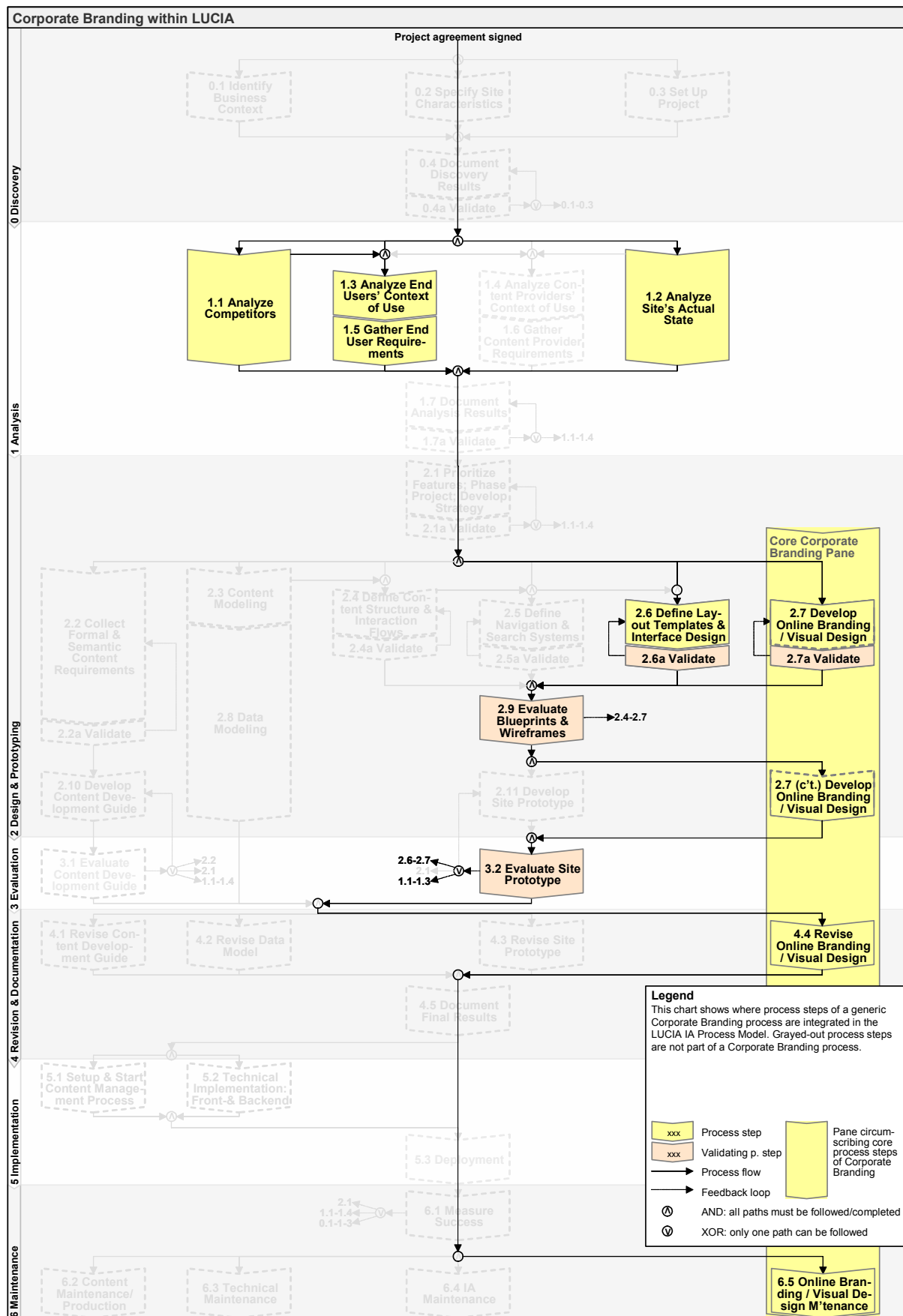


Figure 5-8: LUCIA 1.0: Interdisciplinary Integration Diagram for Corporate Branding

Table 5-10: LUCIA V1.0: Corporate Branding process steps covered by LUCIA

Corporate Branding / Visual Design process steps / tasks...^a	...are covered in LUCIA in step(s):
1. Analysis	
a. Business-domain specific design trends and brand labeling trends	-
b. Socio-demographic data of the target audience	1.3; 1.5
c. Psychographic data of the target audience	1.3; 1.5
d. Competitors' brand status	1.1
e. If existing: status quo of brand	1.2
2. Strategic brand concept	
a. Key brand benefit	2.7
b. Desired brand values	2.7
c. Desired brand personality	2.7
d. Verbal brand concept, tonality	2.7
e. Visual brand concept, tonality	2.7
3. Brand name	
a. Listing brand name alternatives	2.7
b. Similarity research, copyright research	2.7
c. Choosing three to four favorites	2.7
d. Evaluating acceptance level and semantic spectrum with target audience, decision	2.7; 2.9; 3.2
4. Brand design	
a. Developing several alternative brand design visions	2.6; 2.7
b. Testing brand designs: association spectra and acceptance level of designs	2.7; 2.9; 3.2
5. Implementation	
a. Copyright documentation	4.4
b. Brand design style guide	4.4
6. Maintenance (Brand Management)	
a. Conceptual phase: analyze status quo of brand and target audience (steps 1.a-e); develop creative brief	6.5
b. Coding phase: creative realization (steps 2-5)	6.5
c. Reception phase: target audience interpretation of and response to brand	6.5

^a Corporate Branding process steps according to Lackum, 2004; Langner, 2003; Ruckelshauß & Prenzel, 2004; Schneider et al., 2003; see 2.2.4.1 for details.

6 Conclusions and Future Research

The objective of this thesis was to develop a novel, comprehensive Information Architecture (IA) process model describing the design of a website's IA system. The overall purpose of developing the model was to resolve root causes for and thus alleviate the impact of web-specific deficiencies for end users of web-based information systems, and thereby to improve business performance of the sponsoring organization. In the following, the results of the thesis are discussed in light of their practical and scientific impact. In addition, the methodological approach is reviewed, and directions for future research are outlined.

Results of the Thesis and its Impact on the Practice of Website Development

The IA Process Model proposed in this thesis, together with its underlying IA System Model, has been shown to be capable of delivering effective and efficient IA process instances for variable project conditions (see 4.7). For the practice of IA, this implies more effectiveness in developing and implementing high-quality IA systems, resulting in websites that are more successful in terms of business goal achievement. In addition, IA practice also benefits from the detailed documentation of dependencies of IA system components, and their translation into a systematic and thus more efficient, resource-saving process flow, which is also supported by the extensive scalability of the model. The interdisciplinary and holistic approach of the IA Process Model, concluded from the many cross-disciplinary dependencies of IA system components, together with the flexible definition of roles in web teams supported by the model, facilitates the vital interdisciplinary collaboration and adequate allocation of responsibilities in web teams.

The explicit alignment of IA with Corporate Branding processes, and the deliberate emphasis on identifying the business context of the sponsoring organization as a foundation for the IA system design, makes sure that business needs of the organization are adequately balanced and aligned with end user needs. In addition, the previously unavailable close integration of IA with Database Design processes warrants technical feasibility of the IA system, minimizes late design changes and deficiencies of the final website due to technical con-

straints, allows for deliberate trade-off decisions enforced by technical limitations, and supports the Database Design process with valuable input regarding end user needs. Furthermore, the unique twofold user-centered approach to IA system design proposed in this thesis, which next to end users actively involves content providers as a second major user group of an IA system, ensures overall feasibility and usability of the IA system for them. This close alignment of end user needs and content provider capabilities results in an improved Content Management process, which in turn yields higher-quality content.

In sum, the IA Process Model proposed in this thesis, unlike previous IA process descriptions, is indeed capable of addressing and resolving the root causes for deficiencies of web-based information systems that impede end users. As on the web, business success is largely determined by the degree to which users can achieve their goals (see Chapters 1 and 2.3.1), this model also provides a valuable means of improving business performance for a website's sponsoring organization. Figures for return on traditional Usability Engineering (UE) investments have been shown to range between 38% and 10,000% (see 2.3.5.3); given the multitude of the model's additional benefits, even for other disciplines involved, the overall figures for projects conducted according to the present IA Process Model very likely will keep up with or even outperform these figures.

Methodological Considerations

To achieve these results, a results-driven approach was followed in this thesis. The accordingly exhaustive initial analysis of IA system components, their dependencies, and deficiencies, proved beneficial in that it provided a previously unavailable, comprehensive and in-depth treatment of elements critical in defining how information is organized and accessed in web-based information systems. As such, it acted as the major starting point for developing the IA Process Model, identifying the scope of such a process, the target states of its deliverables, and providing the foundation for defining the overall IA process flow.

The literature reviews conducted for this purpose on IA system components, their deficiencies and dependencies, as well as on IA processes and their deficiencies, considerably relied on documents retrieved from online resources. Although online material frequently suffers from various deficits, regarding the quality of information provided (as described in 2.3.2.1), in this case, the use of online material proved beneficial because:

- Up to now, only a few IA books and articles in traditional journals have been published; as described in 2.1, IA is a very young discipline with no established publication environment (e.g., print journals), except for online publications.

- Especially for the meta-level questions addressed here on IA systems and processes, there is hardly any material available yet; an omission of relevant online material, therefore, would have implied a significant loss of information.
- Since its beginnings, the discipline of IA is subjected to a rapid evolution; to follow latest trends and gain insight in the status quo of discussions relevant to the questions addressed here, online material was better suited due to quick publication cycles.
- Because of reduced editorial constraints, online material frequently reflects the *actual practice* of IA in industry more accurately than traditional publications would, which usually are subjected to strict editorial processes that raise the overall threshold to publish and often enforce “optimization” of unwanted facts.

The analysis of available literature was mostly performed using Qualitative Content Analysis, which due to its focus on identifying and structuring relevant material was well suited for the mostly exploratory research performed here. Adjusting the overall procedure of Qualitative Content Analysis to particular constraints at hand allowed for an overall efficient analysis. The software employed here (ATLAS.ti) proved beneficial for efficiently coding the material, and for grouping and revising categories; however, the support for visualizing category structures rather turned out to be insufficient with the current version of the software.

In the course of this thesis, great importance was attached to capturing and incorporating real-life, practical experiences for both analyzing current IA systems and processes, as well as evaluating the final IA Process Model, which ensured the IA Process Model having maximum relevancy and applicability in the field. To this end, immediate and unfiltered access to three major target audiences was sought: end users, content providers, and IA experts.

Thus, for analyzing end-user relevant IA system deficiencies, raw data from previously conducted usability tests of a Siemens Employee Portal was readily available. Unlike reports found in the literature, this allowed for an immediate, genuine, and detailed access to an extensive number of internationally assessed usability problems end users of a large website experienced. However, the usability tests inevitably did not cover every component of an IA system, which then had to be balanced with additional literature reviews. In addition, as documentation of individual usability problems was partly not self-explanatory, some had to be clarified laboriously with the responsible usability engineers. Future research in this direction would hence benefit from usability tests being explicitly focused beforehand on the components of an IA System Model, and explicitly documenting for each usability problem the IA system components involved. In the validation project, the medium level of formalization for

the usability tests with end users allowed for a flexible, yet sufficiently standardized testing. The actual procedure, which involved users verbalizing their thoughts while performing typical tasks, and answering the 5-UD questionnaire after each task, allowed for detailed, multi-dimensional analysis of a single task by delivering in-depth qualitative (participants' comments), as well as extensive quantitative data (# of mistakes made, # of hints given, 5-UD ratings). Here as well as in the content provider walkthroughs, the multi-dimensional combination also counterbalanced the risk of misinterpreting results from the 5-UD due to its potentially low reliability. For both end users and content providers, the 5-UD delivered valuable results and proved beneficial especially due to its short completion time, which both ensured the necessary short overall duration of sessions, and at the same time allowed for evaluating each task separately.

The first-time application of user-centered design methods with content providers in the context of IA system development proved beneficial. The semi-structured field interviews with them on IA system deficiencies, as well as the Consolidated Assessment during the validation project, provided a valuable means of analyzing overall context of use, and of gathering vital requirements for IA systems. Both methods also allowed for the required flexibility, for example in that the researcher could adapt to a respondent's individual terminology. Performing sessions at the respondents' workplace enabled them to illustrate issues with their individual Content Management Systems (CMS) and content objects, which both facilitated discussion and enhanced results. While Consolidated Assessment also confirmed to be a very efficient method, substantial effort was involved in transliterating and qualitatively analyzing the audio taped interviews on IA system deficiencies; although very thorough therewith, a second researcher taking notes for later analysis here would have been more efficient. The walkthroughs in the validation project proved to be an effective and efficient method for evaluating an IA system's feasibility and usability for content providers, without having the need to have a CMS or a respective prototype in place.

Interviewing IA experts on dependencies of IA system components was especially imperative, as these dependencies are only partially described in available literature. The stimulus material provided in the interviews facilitated the discussion, triggered new ideas, and at the same time served as tool for documenting dependencies, which together with the interviewer's notes allowed for an efficient data analysis afterwards. With the expert evaluation focus groups, it was possible to adjust the model to participants' real-life, personal experiences with IA projects and processes, which warranted the model's applicability in everyday IA practice. As they were conducted in Germany and the US, the focus groups also ensured

idiosyncratic preferences regarding IA processes (e.g., country-specific role definitions) being accounted for, and thus added to the international validity of the model.

As during process setup, the ARIS process description standard turned out to be insufficient for the objectives at hand, a completely new and unique process description language was devised. While this involves a reduction in the model's accessibility for process experts because of the unfamiliarity of the description language, it was a vital prerequisite in order to be able to describe in detail the optimum temporal succession of and logical relationships between process steps, which was not possible with available process description languages. Perpetuating this visual language at the level of an individual process step specification, enables the reader quickly to establish a semantic connection between the two levels of process documentation.

While the systematic approach in deriving the IA Process Model ensured all relevant aspects regarding the quality of IA processes being accounted for, the complexities and resource-constraints of the task did not allow for every intermediate result being documented in detail. Thus, for example, in identifying IA process deficiencies, it was not possible to explicitly document what deficient activities or events are responsible for a given process step's contribution to a particular IA system deficiency. As a result, in this thesis, the founding three principles of translating a given system deficiency into an improvement of an IA process step or the overall process flow are described, while only one concrete example for this translation is given. Although this involves an inevitable, minor decrease of traceability for the reader, it did not impair the actual development of the process model, as informal detailed documentation was readily available in terms of notes and handwritten diagrams.

Translating key target criteria for the IA Process Model into measurable objectives for the validation project involved several challenges. Thus, for example, measuring effectiveness of the process instance (TC1) in terms of improved business goal achievement was partly dependent on the redesigned IA system being implemented by the client. Due to planned, but not realized reorganization efforts within the client's departments, implementation could not be started, and thus, this sub-criterion TC1.2.1 had to be evaluated by concluding from results of usability tests with the website's prototype to the semantic requirements of the criterion being met. However, this restriction only applied to one out of four sub-criteria for effectiveness; the remaining three could be operationalized and evaluated in a straightforward manner. The incremental detailing of the three key target criteria throughout development and evaluation of the process model allowed both for directing initial efforts, as well as for an adjust-

ment of these criteria to tangible and measurable goals of the validation project. While the logical dependencies between target criteria (i.e., operationalization of TC2 by TC1; TC3 by TC1 and TC2) rendered target criteria impossible to be evaluated separately, an operationalization of efficiency and scalability independent from measures of actual effectiveness would have been neither practical nor meaningful.

In sum, the postulated key target criteria were fully met by the IA Process Model, and thus, the model has been shown remarkably to provide effective and efficient process instances in variable conditions. It has to be noted, though, that, from an empirical view, the results of the validation project do not represent a scientifically valid proof for the alleged qualities of the process model. Thus, for example, only one project with a relatively small number of participants was conducted, which threatens reliability of results, and the project was conducted by the author, thereby introducing potential experimenter bias. However, a tightly controlled testing environment as well as larger numbers of projects and participants required for such a valid scientific proof is typically not achievable in an applied context such as IA system development, especially not without unduly damaging in particular external validity, which in turn renders results useless for the practitioner, as pointed out by Wixon (2003). Thus, to actually improve the practice of user-centered design disciplines, processes and methods indeed have to be evaluated *in vivo*, i.e., in real-life conditions, applying business- and engineering-relevant criteria, which consequently requires the very case-study approach adopted here. Further evaluating and improving the model therefore requires more projects with different conditions to be performed according to the model, while accounting for internal validity and reliability threats as much as possible (see Wixon, 2003). Thus, in the future, the model hopefully is employed broadly by IA experts in the field to carry out IA projects of varying focus and scope, whose results then in turn can be used to further evaluate and refine the model and its postulated qualities.

Scientific Impact on Psychology, Human-Computer Interaction, Usability Engineering, and IA Information Architecture, just like any other User-Centered Design (UCD) discipline, per se offers psychologists and other behavioral, cognitive, or social scientists a professional area to apply their *analytical* expertise, for example by validating IA system designs or analyzing user needs. However, as Norman (2001) pointed out, to become an integral part of product development, Psychology has to reach beyond its self-imposed, limited focus of mere analysis, and psychologists have to become vital, irreplaceable “leaders” in the *creative* stages of product development that actively shape the product’s definition and its system design. The present thesis puts this call into practice by explicitly and in detail documenting what psy-

chologists, HCI experts, and other UCD-professionals can contribute in particular to product definition and system design (e.g., user-centered design of metadata schemata), and how they can benefit other, psychology-distant disciplines like Database Design. As such, this thesis also proves the value of these “soft” professions taking over responsibilities in those stages of product development, and thereby provides the foundation for an expanded scope of Applied Psychology and its inventory of established tools and methods. Ultimately, the research approach of the thesis in itself, which focuses on alleviating web-specific deficiencies rather than merely analyzing them (see Chapter 1), represents an academic manifestation of Norman’s (2001) call for Psychology to get more involved in solving problems within product development.

From a Human-Computer Interaction viewpoint, the large proportion of content-related IA system deficiencies for end users was particularly interesting, as much of the available literature on web usability rather focuses on aspects of the user-interface. Although acknowledging the large impact of low-quality web content is referred to for example also by Nielsen (1999; 1999a; see 2.2.7.2), and listed as a major challenge for the discipline of IA in the future (see 2.1.7), this has not been sufficiently translated into the actual practice of IA and Usability Engineering (UE) until now.

The first-time systematic implementation of UE methods with content providers in the context of IA system development, founded on previously unavailable broad evidence for the impact that a particular IA system design exerts on content providers’ goal achievement, provides a significant extension to the traditionally end-user centered approach of UE. One of the few who have addressed these issues in the past is Vora (1998; similarly Garrett, 2002a; see 2.1.4.3), who calls for understanding the needs of prospective content authors and editors before designing a website’s interface; yet, in this model, the usability of metadata schemata and other IA components for them is not addressed, and the resulting user interface design is not evaluated with content providers either. In the context of Content Management System (CMS) development, Warren (2001), as well as Boiko (2002), also suggests gathering requirements from content providers, and usability test the CMS interface with them (see 2.2.7); however, these delineations only pertain to dedicated CMS-, but not IA system development projects.

The definitions for IA *system* and *process* proposed in this thesis take on a rather broad perspective on Information Architecture. Implicitly, they also shed light on the wide range of issues a *discipline* of IA is to be concerned with (e.g., in an IA curriculum), and therefore, do not immediately comply with Garrett’s (2002; see 2.1.2.6) call for narrowly defining the dis-

cipline of IA. However, the approach taken here is rather to acknowledge the overlap in scope of disciplines involved in information system development. As this overlap is only a natural expression and counterpart of the interdependent nature and shared liability of information system components for end user goal achievement, striving for supposed mutually exclusive definitions here would only perpetuate the misleading illusion of independent, single-discipline development processes within information system development. These dependencies, in turn, are the deeper reason for the collaborative and interdisciplinary approach to IA system development argued for in this thesis. It is important to note that the definitions adopted here explicitly do not diminish other disciplines' area of accountability. Rather, the *core* of the discipline of IA (as well as other disciplines' core) might still be better defined narrowly (as insisted on by Garrett, 2002), while from IA's overlap with other disciplines, the *periphery* of the discipline IA might be drawn, in order to both advance IA with clear-cut definitions as well as allow for comprehensive coverage of relevant issues.

A discipline as young as IA typically suffers from incompleteness in many a respect (see 2.1.7); the results of the present thesis therefore also present a major contribution to advancing the discipline of IA. Thus, while reaching a final consensus on the definition of IA remains a major challenge for the IA community to be solved in the future (see 2.1.7), the definitions given in this thesis and the underlying rationale have proven to be valuable for both the theory and practice of IA. The six-component IA System Model provides a previously unavailable, comprehensive and in-depth description of IA-critical elements of a web-based information system, those elements' possible deficiencies, and their multifaceted dependencies. Together, the definitions and the IA System Model present a uniquely holistic and well-founded conceptualization of IA, and thus also a vital prerequisite for further research in IA.

The explicit and detailed integration of IA processes with Database Design in the IA Process Model also brings about the previously lacking alignment of top-down and bottom-up approaches to IA processes, and thus helps to leverage the power of bottom-up IA. In addition, the comprehensive and interdisciplinary character of the IA System and Process Model resolves the conflicts between IA and other, paralleling disciplines (especially Usability Engineering), by explicating in detail how these disciplines, the roles, the processes, and respective deliverables intertwine. Finally, the model also involves a significant improvement on established IA methods and deliverables through the comprehensive aggregation of relevant methods, practical-experience based description of where in overall process individual methods are applicable, and the support for transparent and efficient selection and use of methods.

The Future of the Web, Website Development, and the IA Process Model

The IA Process Model proposed in this thesis has been shown to be capable of resolving the current web-specific deficiencies and their root causes; in the future, however, new developments will challenge the design of websites and their IA systems, and thus the IA Process Model. Three major lines of development include:

- Continuing growth of information
- Pervasive deployment of location-based web services
- Turning the web into a semantic web

Continuing growth of information: as described in 2.3.2.1, the amount of information very likely will continue to increase in the future, even at an accelerated pace, with the proportion of low-quality content not necessarily dropping. For an organization to stay competitive within such an ever-increasing, tangled mass of information offerings, requirements posed on information quality will likely have to be tightened, and creation cycles will have to be shortened, which in sum will pose higher demands on content providers. The achievability of respective requirements with the given Content Management resources, together with the overall usability of tools they use, will largely determine the success of such efforts. Therefore, in order to reduce information input overload symptoms on the users' side (see 2.3.5.2), in the future, the need for assessing content provider needs and capabilities with regard to the to-be developed IA system, and for matching these with end user requirements in a concerted IA system design, will become even more pressing, which in turn confirms the approach described in the present IA Process Model.

Pervasive deployment of location-based web services: in order to meet special needs of geographically circumscribed target audiences, more and more organizations will provide localized content and services. The concomitant need for customized, permanently updated information calls for flexible, focused Content Management teams and fast publication cycles. Again, it will be crucial to support content providers with usable tools and match end users' interface and content requirements with their capabilities. The IA Process Model proposed in this thesis thus is also a vital means to realize the benefit of location-based web services.

Turning the web into a semantic web: as described in 2.1.3.2 and 2.3.2.3, in order to alleviate technical limitations of the web, advance automated processing of web content, and improve end user access to information on the web, current efforts aim at turning the web into a semantic web by pervasively implementing structural and other metadata. Although much of this metadata, such as the author's name or valid dates, can be collected automatically by a

CMS, many metadata attributes, especially descriptive metadata, such as topic, keywords, and target audience, still require human effort to yield high-quality information about the content. Thus, the realization of the semantic web, which is viewed by many experts as the major crossroad for the next generation of the web, is fundamentally dependent on authors, editors, and content managers willing and being able to provide high-quality metadata for the content they create and manage (e.g., Doctorow, 2001). In turn, this will be largely determined by how usable the respective metadata schema and controlled vocabularies are, which they are meant to use as a framework and tool for adding metadata values to their content objects. Ensuring the usability of metadata schemata and controlled vocabularies for content providers, and integrating this task in a comprehensive IA system development process, in turn, is a unique and previously not available key feature of the IA Process Model, which therefore is a major cornerstone for realizing the semantic web.

In conclusion, with the IA Process Model proposed in this thesis, key ingredients for improving user and business goal achievement in information systems are readily available. While it is capable of accounting for and resolving present deficiencies of web-based information systems and their root causes, it furthermore provides a unique and powerful instrument to overcome future challenges and seize the infinite opportunities of the web. In doing so, it contributes significantly to the information age turning into a success story, which likely will advance humankind to a degree unparalleled ever since the introduction of the first printed book.

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Appendix

Appendix A: Background: Details

Appendix A-1: Usability measures for specific product properties

Usability objective	Effectiveness measures	Efficiency measures	Satisfaction measures
Meets needs of trained users	<ul style="list-style-type: none">▪ Number of power tasks performed;▪ Percentage of relevant functions used	<ul style="list-style-type: none">▪ Relative efficiency compared with an expert user	<ul style="list-style-type: none">▪ Rating scale for satisfaction with power features
Meets needs to walk up and use	<ul style="list-style-type: none">▪ Percentage of tasks completed successfully on first attempt	<ul style="list-style-type: none">▪ Time taken on first attempt ^a;▪ Relative efficiency on first attempt	<ul style="list-style-type: none">▪ Rate of voluntary use
Meets needs for infrequent or intermittent use	<ul style="list-style-type: none">▪ Percentage of tasks completed successfully after a specified period of non-use	<ul style="list-style-type: none">▪ Time spent re-learning functions ^a;▪ Number of persistent errors	<ul style="list-style-type: none">▪ Frequency of reuse
Minimization of support Requirements	<ul style="list-style-type: none">▪ Number of references to documentation;▪ Number of calls to support;▪ Number of accesses to help	<ul style="list-style-type: none">▪ Productive time ^a;▪ Time to learn to criterion ^a;	<ul style="list-style-type: none">▪ Rating scale for satisfaction with support facilities
Learnability	<ul style="list-style-type: none">▪ Number of functions learned;▪ Percentage of users who manage to learn to criterion	<ul style="list-style-type: none">▪ Time to learn to criterion ^a;▪ Time to re-learn to criterion ^a;▪ Relative efficiency while learning	<ul style="list-style-type: none">▪ Rating scale for ease of learning
Error tolerance	<ul style="list-style-type: none">▪ Percentage of errors corrected or reported by the system;▪ Number of user errors tolerated	<ul style="list-style-type: none">▪ Time spent on correcting errors	<ul style="list-style-type: none">▪ Rating scale for error handling
Legibility	<ul style="list-style-type: none">▪ Percentage of words read correctly at normal viewing distance	<ul style="list-style-type: none">▪ Time to correctly read a specified number of characters	<ul style="list-style-type: none">▪ Rating scale for visual discomfort

Notes. Source: ISO 9241-11, 1998, p. 11

^a In these examples, the resources should be measured in relation to a specified level of effectiveness.

Appendix A-2: The 5 Usability Dimensions Attitude Scale

5 Usability Dimensions Attitude Scale		
Please read each question below. Circle one number which best indicates how near or far you think the software you are rating is from each of the two indicated poles.		
How efficient do you feel you get your work done with this software?		
Badly: software keeps on getting in the way.	1 2 3 4 5 6 7 8 9	Well: work goes very efficiently.
Do you like using this software?		
No: It is very stressful and unpleasant to use.	1 2 3 4 5 6 7 8 9	Yes: I really enjoy using it.
Does this software help you how to use it?		
No: there's never enough information when you need it.	1 2 3 4 5 6 7 8 9	Yes: all the information I need to have is there.
Do you feel in control when you use this software?		
No: the software feels as if it controls me.	1 2 3 4 5 6 7 8 9	Yes: I can make the software do all I need it to do.
Do you think it's easy to get started with this software?		
No: it gives you a very hard time at the beginning.	1 2 3 4 5 6 7 8 9	Yes: You can get into it right away.

Notes. Source: ISO DIS 9241-11, 1993

Appendix A-3: Prototyping methods

Prototype	Description	Benefits	Shortcomings
Paper or cardboard mock-up	fabricated devices with simulated controls or display elements, using screen shots and/or hand sketched page diagrams; a member of the team sits before a user and 'plays the computer'	<ul style="list-style-type: none"> cheap and quick, thus less reluctance to iterate on supports participatory design activities can be used very early in the design process clear separation of design- and development, thus easy to iterate communication between designers and users is promoted. only minimal resources and materials are required to convey product feel. the technique can be utilized even with little or no human factors expertise. 	<ul style="list-style-type: none"> cannot be used to evaluate design details or provide metric data due to its simplicity cannot reliably simulate system response times the person simulating the computer must have in-depth knowledge of the intended functionality
Wizard of oz prototype	workstation connected to invisible human assistant (the 'wizard') who emulates input, output, or processing functionality not yet available for technical reasons or lack of resources; a variant of computer-based prototyping	<ul style="list-style-type: none"> can be used very early in the design process especially helpful for systems which go beyond available technology particularly suited to multimedia and telematics applications. The 'wizard' can gain valuable insights from the close interaction with end-users. 	<ul style="list-style-type: none"> lacks the general applicability of other prototyping approaches more resources needed than in paper prototyping the 'wizard' must have in-depth knowledge of the intended functionality to provide a convincing representation
Video prototype	Video recording displaying the functionality of a system using e.g., paper prototypes; users do not directly interact with the prototype, but comment on the simulation.	<ul style="list-style-type: none"> can be used very early in the design process (before coding) provides a dynamic simulation of interface elements that can be viewed and commented on only minimal resources and materials are required to convey product feel the technique can be utilized even with little or no human factors expertise. 	<ul style="list-style-type: none"> additional resources needed to create the video representation no real interaction of user with prototype cannot be used to evaluate design details or provide metric data due to its simplicity

Computer-based (rapid) prototype	Interactive system, often created with special ('rapid') prototyping tools	<ul style="list-style-type: none">▪ very realistic, high-fidelity prototypes▪ can be used to gain metric data▪ rapid prototyping allows for quick development of interactive software prototypes	<ul style="list-style-type: none">▪ more resources and time needed than with other prototypes▪ thus, more reluctance to throw away and iterate on the prototype▪ rapid prototyping requires software development skills
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Notes. Sources: Rosson & Carroll, 2002; Doss, 2002; Maguire, 1998; Gaffney, 2002; Daly-Jones et al., 1999; Nielsen, 1993

Appendix B: Realization: Detailed Materials and Results

Appendix B-1: Step 1: IA System Analysis

Appendix B-1.1: Step 1.2: Interviews with Content Providers

Recruiting script (in German)

Vorstellen: Person, Verweis auf Referrer		
Guten Tag, mein Name ist N.N. von CT IC 7. Haben Sie kurz Zeit? Ich hätte ein, zwei Fragen an Sie.		
Falls nicht: Termin für Telefongespräch: am _____ um: _____ unter: _____		
Und zwar geht es um folgendes: Ich arbeite zusammen mit André Epstein (IC7) und Thomas Falter (CIO) an dem Teilprojekt Informationsarchitektur für das zukünftige Enterprise Portal. Das Projekt wird geleitet von Frau Petra Kamm.		
Genau zu diesem Thema Informationsarchitektur schreibe ich gleichzeitig eine Dissertation.		
N.N hat mir empfohlen, mit Ihnen Kontakt aufzunehmen. Ich bin nämlich auf der Suche nach Ansprechpartnern für den Content Management Prozess innerhalb des Siemens Employee Portals.		
Gesuchtes Profil I		
N.N hat mir darauf ihren Namen genannt, weil sie nach seinem Wissen ...		
...		
Meine erste Frage wäre also, ob Sie tatsächlich in irgendeiner Weise am Content Management Prozess für das Employee Portal beteiligt sind, d.h. ob sie am Verwalten der Inhalte in irgendeiner Form beteiligt sind? Oder verantwortlich?		
Antwort		Anweisung
Entwickeln, Verwalten, Überarbeiten des CM-Prozesses	<input type="checkbox"/>	
Erstellen neuer Inhalte für das Portal	<input type="checkbox"/>	
Einstellen dieser Inhalte in das Portal	<input type="checkbox"/>	
Anfügen von Metadaten an neue Inhalte	<input type="checkbox"/>	
Verwalten von Metadatenlisten, ...	<input type="checkbox"/>	
Verwaltung einer (Unter-) Kategorie	<input type="checkbox"/>	
Verantwortliche für Neuerstellung einer (Unter-) Kategorie im Portal	<input type="checkbox"/>	
Integrieren von Site Wachstum und Veränderung	<input type="checkbox"/>	
Portal application Owner	<input type="checkbox"/>	
	<input type="checkbox"/>	
Interview-Anfrage		
Unser Ziel ist es, herauszufinden, ob und wenn ja wie eine schlechte Informationsarchitektur Ihre Arbeit als Content Manager beeinträchtigt.		
Daher wäre meine Frage jetzt, ob Sie sich Zeit nehmen möchten für ein Interview, bei dem wir uns zusammen dann anschauen würden was sie an Content Management Tätigkeiten für das Portal zu tun haben.		
Das Interview dauert nicht länger als maximal 1 Stunde. [und für Ihre Mitarbeit werden Sie mit ... entlohnt.]		
Antwort		Anweisung
Ja	<input type="checkbox"/>	
Nein	<input type="checkbox"/>	
Tonaufnahme		
Eine Frage noch: Erfahrungsgemäß fließen bei solchen Gesprächen sehr viele Informationen, mehr, als man auf die Schnelle so mit notieren könnte. Hätten sie daher was dagegen, wenn wir das Gespräch auf Minidisc aufnehmen?		
Natürlich wäre das nur für die Auswertung und wird in keinem Fall ohne Ihre Zustimmung veröffentlicht oder Dritten zugänglich gemacht.		
Antwort		Anweisung

Ja	<input type="checkbox"/>	
Nein	<input type="checkbox"/>	
Terminvereinbarung		
Bejaht: Ok, wann würde es Ihnen denn passen?		
Antwort am: um: Wo:	Anweisung	
Dankeschön, Verabschiedung		
Bejaht: Ok. Dann bedanke ich mich erst mal für ihre Mitarbeit und hoffe, dass wir damit später auch Ihnen Ihre Arbeit erleichtern können.		
Zusätzliche Info I: Das Projekt – um was geht es?		
In unserem Teilprojekt Informationsarchitektur geht es eigentlich um zwei Dinge: zum einen darum, wie Informationen auf der Benutzeroberfläche für den Endnutzer angeordnet werden, also wie sie sich durchklicken können, andererseits aber auch darum, wie die Informationen verwaltet werden, also z.B. wie neue Inhalte im Portal verfügbar gemacht werden.		
Zusätzliche Info II: Grund für Kontaktaufnahme: Warum spreche ich Sie an?		
Informationsarchitektur ist also immer was Zweigleisiges – Benutzeroberfläche und Verwaltung von Informationen. Und um jetzt sozusagen aus erster Hand zu hören, wo da der Schuh drückt, möchten wir jetzt erst mal Interviews mit den „Betroffenen“ führen, also sowohl mit Endnutzern als auch mit denen, die für diese Verwaltung von Informationen zuständig sind.		

Interview Guide for Iteration 1 (in German)

Vorstellen: Person, Verweis auf Referrer		
Und zwar geht es um folgendes: Ich arbeite zusammen mit André Epstein (IC7) und Thomas Falter (CIO) an dem Teilprojekt Informationsarchitektur des EMEA Enterprise Portal Projekts, das von Frau Petra Kamm geleitet wird. N.N hat mir empfohlen, mit Ihnen Kontakt aufzunehmen. Ich bin nämlich auf der Suche nach Ansprechpartnern für den Content Management Prozess innerhalb des Siemens EMEA Employee Portals. Ziel der Interviews wäre es, herauszufinden, ob eine schlechte Informationsarchitektur ihre Arbeit für das Portal beeinträchtigt und wie man das besser machen könnte. Das Interview dauert nicht länger als maximal 1 Stunde. [und für Ihre Mitarbeit werden Sie mit ... entlohnt.]		
Das Projekt – um was geht es?		
In unserem Teilprojekt Informationsarchitektur geht es eigentlich um zwei Dinge: zum einen darum, wie Informationen auf der Benutzeroberfläche für den Endnutzer angeordnet werden, also wie sie sich durchklicken können, andererseits aber auch darum, wie die Informationen verwaltet werden, also z.B. wie neue Inhalte im Portal verfügbar gemacht werden. Genau zu diesem Thema Informationsarchitektur schreibe ich gleichzeitig eine Dissertation.		
Grund für Kontaktaufnahme: Warum spreche ich Sie an?		
Informationsarchitektur ist also immer was Zweigleisiges – Benutzeroberfläche und Verwaltung von Informationen. Und um jetzt sozusagen aus erster Hand zu hören, wo da der Schuh drückt, möchten wir jetzt erst mal Interviews mit den „Betroffenen“ führen, also sowohl mit Endnutzern als auch mit denen, die für diese Verwaltung von Informationen zuständig sind.		
Bereits vorliegende Daten - Tätigkeitsprofil I		
In unserem ersten Gespräch am Telefon haben sie mir ja schon kurz erzählt, was sie machen im Zusammenhang mit der Verwaltung von Inhalten des Portals. Das waren:		
Antwort	Anweisung	
Erstellen neuer Inhalte für das Portal	<input type="checkbox"/>	
Einstellen dieser Inhalte in das Portal	<input type="checkbox"/>	
Anfügen von Metadaten an neue Inhalte	<input type="checkbox"/>	
Verwalten von Metadatenlisten, ...	<input type="checkbox"/>	

Verwaltung einer (Unter-) Kategorie	<input type="checkbox"/>	
Verantwortliche für Neuerstellung einer (Unter-) Kategorie im Portal	<input type="checkbox"/>	
	<input type="checkbox"/>	
	<input type="checkbox"/>	
	<input type="checkbox"/>	
Tätigkeitsprofil II		
Gibt es sonst noch was, das zu diesem Bereich gehört? Können Sie mir kurz schildern, für welchen Aufgabenbereich Sie verantwortlich sind?		
Szenario 1: Einfügen eines Inhalts		
Jetzt wäre es am besten, wenn wir einmal Schritt für Schritt durchgehen, wie Sie neue Informationen in das Portal einstellen. Erinnern sie sich dafür am besten an eine der letzten Male, wo sie dies getan haben. (...)		
Dann erzählen sie mir doch bitte von Anfang an, wie das abgelaufen ist. Am besten wäre es, wenn sie es mir direkt am Bildschirm zeigen könnten.		
Also, wodurch wurde diese Aufgabe ausgelöst?		
Szenario 1 Probleme:		
Wenn Sie sich erinnern, welche Probleme sind denn dabei aufgetreten? Oder welche Probleme sind dabei allgemein schon aufgetreten?		
Szenario 2: Erstellen einer Kategorie		
Wenn Sie für einen Inhalt keine passende Kategorie finden, wie gehen Sie dann vor? Wie können Sie dann evtl. eine neue Kategorie einfügen? Erzählen Sie mir bitte wieder von Anfang an, wie so etwas typischerweise abläuft.		
Szenario 2 Probleme:		
Wenn Sie sich erinnern, welche Probleme sind denn dabei aufgetreten? Oder welche Probleme sind dabei allgemein schon aufgetreten?		
Szenario 3: Anordnen von Kategorien		
Hatten Sie schon einmal die Aufgabe, mehrere Kategorien für Ihren Bereich anzuordnen? Wie sind Sie dabei vorgegangen? Wieder am besten an einem Beispiel, von Anfang an und Schritt für Schritt.		
Szenario 3 Probleme:		
Wenn Sie sich erinnern, welche Probleme sind denn dabei aufgetreten? Oder welche Probleme sind dabei allgemein schon aufgetreten?		

Interview Guide for Iteration 2 (in German)

Aspekt	Frage
Content framework	
Content scope	Objekt innerhalb des Scopes des ShareNet ? Objekt relevant für das ShareNet? Wussten Sie, welche Inhalte im Knowledge Library erwartet werden? Wussten Sie, ab wann etwas als Knowledge Object gilt, d.h. welche Voraussetzungen erfüllt sein müssen? Waren diese Vorgaben hilfreich?
Content granularity	Erwartete Detailtiefe klar? Erwartete Detailtiefe zu fein? Konnten sie zu jedem inhaltlichen Bereich (z.B. reasons for success/failure) Angaben machen? Wussten Sie, wie detailliert sie einzelne Aspekte darstellen mussten? (z.B. reasons for success) Erwartete Detailtiefe zu grob? Konnten sie mit den inhaltlichen Bereichen (z.B. reasons for success/failure) ihr

	Objekt ausreichend beschreiben?
	Waren diese Vorgaben hilfreich?
Content wording	Wussten Sie, welche Sprache (Fachsprache, allgemeinverständlich, einzelne Fachbegriffe) sie benutzen sollten? Gab es Anforderungen (z.B. so einfach wie möglich)? Waren diese Vorgaben hilfreich für sie?
Content media type	Wie haben sie die Entscheidung getroffen, in welchen technischen Format sie Objekte hochladen, z.B. .doc oder .pdf?
Content functionality	
Organization systems	
Classification:	Attribute zu viele? Konnten sie alle geforderten Attribute für ihr Objekt angeben? Attribute zu wenig? Hat ihnen ein Attribut gefehlt, das sie gerne angegeben hätten? Auswahlmöglichkeiten Waren die Vorgaben/Auswahlmöglichkeiten hilfreich für sie? Oder hätten sie lieber frei bestimmt? Zahl der Auswahlmöglichkeiten? Empfanden sie die Zahl der Attribute als zu umfangreich, zu wenig, oder genau richtig? Ist die Zahl der Attribute auch für andere Objekte angemessen? (z.B. news oder urgent request)
Categorization: Categorization criterion	Haben die Kriterien für die Kategorisierung ihren Bedürfnissen entsprochen? Hätten sie gerne andere Kategoriekriterien genutzt? (z.B. ihre Org-Unit)
Categorization: Categorization structure	
Layout	Hat das vorgegebene Layout ihren Bedürfnissen entsprochen? Waren diese Vorgaben hilfreich für sie?
Navigation Systems	
Embedded nav (Global, local & contextual nav)	Konnten Sie Verknüpfungen zu anderen Objekten anlegen?
Supplemental nav (Guides/wizards, Site maps/TOCs, Indexes)	Konnten Sie Begriffe angeben, unter denen ihr Objekt in einem Index aufzufinden ist?
Additional nav	
Collaborative filtering devices	
Personalization, Customization	
Search Systems	
Search engine	Fiel es ihnen leicht, Begriffe anzugeben, mit denen ihr Objekt von der Suchmaschine gefunden wird? (z.B. keywords)
Search/retrieval algorithms	
Query languages	
Search zones	
Search interface	
Search query input	
Search results display	
Labeling systems	
labels as headings	
labels as index terms	
labels within navigation systems	

Interview Protocol Template for Iteration 2

Scenario:			
Content			Navigation Systems
<ul style="list-style-type: none"> Content scope Content granularity Content wording Content media type Content functionality 			<ul style="list-style-type: none"> Embedded nav (Global, local & contextual nav) Supplemental nav (Guides/wizards, Site maps/TOCs, Indexes)
Organization systems			Additional nav
Classification			<ul style="list-style-type: none"> Collaborative filtering devices Personalization, Customization
<ul style="list-style-type: none"> Metadata systems, incl. CVs & Content Type Classes 			Search Systems
Categorization			Search engine
<ul style="list-style-type: none"> Categorization criterion Categorization structure 			<ul style="list-style-type: none"> Search/retrieval algorithms Query languages Search zones
Layout			Search interface
			<ul style="list-style-type: none"> Search query input Search results display
			Labeling systems
			<ul style="list-style-type: none"> labels as headings labels as index terms labels within navigation systems

Appendix B-1.2: Step 1.2: Analysis of IA System Deficiencies

Initial Coding Guide for IA System Deficiencies (in German)¹⁷²

IA system component	Definition of component / deficiency	Key example
Content framework	Allg. Inhalt, insbesondere Qualität des Inhalts,	„Hilfe hilft nicht“
Content scope	gewünschter Content fehlt / überflüssiger Content	„Allgemeiner Sicherheitshinweis nervt“
Content granularity	zu viel/zu wenig Information; zu hohe/niedrige Detaillierung, auch: Unklarheit durch zu geringe Info	auch: „Es wird nicht klar, welcher Kaufprozess dargestellt wird“
Content wording	Begriffswahl, Sprachebene, Wortschatz des Textes	
Content media type	Content in falscher Form (technischem Format)	„Flash-Präsentation und kein Player installiert“
Content functionality	Nicht erwartungskonforme Funktionalitäten von Applikationen/Informationen; auch: Login/Logout; auch Sequenzen innerhalb von Applikationen („Task Flow“) (vs. Navigation: Bewegung hin zu gewünschter Information); aber: wenn Link als solcher nicht erkannt wird, ist auch das ein Problem der Funktionalität (vs. wenn der link nicht zum gewünschten Inhalt führt)	„Logo nicht anklickbar“ „Drop-down Liste denkt: med + usa = medusa“ „man kann leider keine Bookmarks einrichten“ „‘Speichern für diese Sitzung‘ was soll das?“
Organization systems	Allgemein Organisation der Inhalte; primär aus Sicht des Content-Managers	

¹⁷² Based on IA System Model V0.1

Classification	Mangelhafte Klassifikation von Informationen aus CM-Sicht (!!Eigentlich nicht: unzureichende Suchergebnisse aufgrund mangelhafter Klassifikation der Inhalte (zu viele / keine Treffer / nicht die richtigen Treffer) daher Codierungen löschen??)	(!! Eigentlich nicht: „Ergebnisse der Suche sind unzufriedenstellend“)
Metadata	Probleme / Defizite bei der Vergabe von Attributen, die sich auf IA zurückführen lassen	
Content Type Classes		
Controlled Vocabularies		
Categorization (site organization)	Organisation der Inhalte aus CM/Editor Sicht; in was der CM die Inhalte einstellt = Organization System; aus Portal-Fktl wird dann für den End User daraus ein personalisiertes, customisiertes Navigation System; Editoren stellen in ein OS Inhalte ein, ein Webmaster / IA entscheidet dann, wie (&wer) in NS auf diese Inhalte zugegriffen werden kann	
Organization scheme		
Organization structure		
Layout (page organization)	Anordnung der Elemente einer einzelnen Seite; auch: Unübersichtlichkeit einer einzelnen Seite; aus Cm-Sicht: Layout nichtideal für einzustellenden Content	„Button nicht gefunden“ „Hilfe nicht erkannt“
Navigation systems	Benutzerbewegung durch den Medienraum, um einen Gegenstand, ein bestimmtes Thema oder einen spezifischen Teil der Information zu finden; („Navigation is a result of the interaction between the elements of a system and the user's goals given that interaction with the system“). Allg. Abfolge und Anordnung von einzelnen Seiten; auch Organisation, jedoch aus End User Sicht	„Warum sind die Links Hotline und Kontakt getrennt“?
Embedded navigation systems	In die Seiten integrierte Navigationssysteme	
Global navigation	Globale Navigation (i.S. von Primärnavigation)	„Warum sind da so viele Reiter?“ „Lernen und Wissen gehört eigentlich nicht in das Hauptmenü, da es zu selten gebraucht wird“
Local navigation	Lokale Navigation (i.S. von Sekundärnavigation)	„Wozu Unterpunkte? Home ist Home“
Contextual navigation	Kontextuelle Navigation	„Bei Scrollseiten kein Zurück zum Anfang“
Supplemental navigation systems	Nicht integrierte, sondern Navigationssysteme, die selbst eigene Seiten beanspruchen.	
Guides/wizards		
Site maps/TOCs		
Indexes		
Collaborative filtering devices		
Personalization, Customization	Auf den Benutzer vom System zugeschnittene bzw. vom Benutzer selbst vorgenommene Vorauswahlen bzgl. der Ausprägung anderer Systemkomponenten (Content, Layout, Labeling, Visual Design)	
Search systems	Suche allg.	
Search engine	Funktionalität der Suche allg., auch: Qualität	„Ergebnisse der Suche sind unzufrieden-“

	der Suchergebnisse	denstellend“
Search retrieval algorithms		
Query languages		
Search zones	Bereich, in dem gesucht wird; von Benutzer bestimmbar	„Suchergebnisse auf Bereich des EP eingrenzen“
Search interface	Interface Design der Suche allg.	
Search query input	Interface Design der Suche bei Eingabe	„Begriffsverknüpfung unklar“
Search results display	Interface Design der Suche bei Ausgabe	„Ergebnisse ohne kurze Ausführung des jeweiligen Inhalts“
Labeling systems	Allg. unklare Begrifflichkeit eines (einzelnen) Wortes, das als Repräsentant für weitere Inhalte fungiert	
labels as headings	Unklare Begrifflichkeit eines Wortes, das als Überschrift eines Inhalts oder Teils eines Inhalts fungiert	„Die Überschriften sollten einheitlich und angemessen geschrieben werden“
labels as index terms	Unklare Begrifflichkeit eines Wortes, das im Zusammenhang mit der Indizierung von Inhalten verwendet wird; auch codiert mit Metadaten aus Organization Systems	
labels within navigation systems	Unklare Begrifflichkeit eines Wortes, das innerhalb von Navigation für die Repräsentation von Inhalten verwendet wird	„Unterschied zwischen Arbeitmittel und Mitarbeiterservice unklar“

Final Coding Guide for IA System Deficiencies¹⁷³ - Deficiencies for End User

IA system component	End user problems	Definition and examples
Content framework		
Content scope		
	missing content	User expectation regarding included information or applications are not met; only if content is missing completely on the site, if it is located somewhere else it is a navigation problem; also: missing timeliness
	unwanted/outdated content	Information or applications are included that the user does not expect, need or want; only if the content should not be there at all in the site, if it should only be located somewhere else, it is a navigation problem; also: outdated content
Content granularity		
	too coarsely grained	The content available is not detailed enough, i.e. it is too superficial to answer a user's information need
	too finely grained	The content available is too detailed, i.e., there is too much detail information so that a user cannot find the answer to his information need
Content wording		
	inadequate level of language	Too sophisticated language, too many technical terms (= language level too high) Language level too low (e.g., "marketing slang")
	inconsistent terminology	Terms are used inconsistently: (1) different terms for the same concept, (2) same term for different concepts
	unclear abbreviations	Abbreviations are unknown, are not introduced
	unclear expressions/terms	Expressions are too vague or unclear; terms are too vague, are not explained properly
	wrong language	Language used (e.g. German vs. English) causes the problems; if not language itself and the meaning of the term in the not-so

¹⁷³ In line with IA System Model V0.2

		well known language is the problem but the actual meaning of a term in the context at hand, then it is a problem of a too high language level
	wrong spelling	Spelling mistakes, inconsistent spelling,
Content media type		
	unwanted/wrong media type	Media type (e.g., .pdf, Flash-Animation,...) is not accepted by the user, user expects other media type
Content functionality		
	missing functionality	Functionality that a user would like to be able to use (e.g. bookmark feature) or would like to have (e.g. more feedback after an action)
	unwanted functionality	functionality that a user does not want to have to use
	unclear functionality	functionality is unclear to the user, i.e. he does not know in advance what an action will result in
	unexpected behavior	Unexpected behavior after an action of the user
Organization systems		
Metadata systems (incl. attributes, Content Type Classes)		
Value Range (VR)		
Content structure		
Criterion		
Categories		
Layout (page organization)		
	complex layout, too much page elements	
	inconsistent layouts	
	layout & screen interaction	
	page elements not salient enough	Single page elements inadequately located, elements not properly arranged
	inadequate separation/aggregation of page elements	Layout does not clearly separate disparate or aggregate/connect similar page elements, which results in inadequate organization of page elements
	too few page elements (no missing content specified)	Not specified what is being missed, only that screen space is not used efficiently
	inadequate typeface	
Navigation systems		
	missing navigation choices	
	unwanted navigation choices	
	unexpected navigation paths	User's expectations regarding the path to a content object are not met, the path is too long or too complicated
Embedded navigation systems		
Global/local navigation	missing navigation choices	
	unwanted navigation choices	
Contextual navigation	missing navigation choices	
Supplemental navigation systems		
Guides/wizards	forced to leave wizard to answer question	
	missing overview (roadmap)	
	no alternative for	

	experienced users available	
	inadequate step-by-step guidance	
	too many screens	
	unclear purpose	
Site maps/TOCs	inadequate level of detail	number of hierarchy levels shown, too detailed descriptions of links
	out of date	
	need for doubled entries	
Indexes	inadequate index structure	unwanted / missing sub-terms, unwanted / missing levels, unwanted / missing references too related terms (see also)
	missing synonyms handling	
	no substantive information for entries	
	too many page numbers for a single entry	
Search systems		
Search engine		
	insufficient response time	search takes too long
	insufficient search results	too many or too less results
	unclear functionality	Not clear, what is searched and how it is searched
Search zones / search fields	missing search zones	
Search thesaurus	inadequate synonym expansion no correction of misspellings	
Search interface		
Search query input	missing functionalities	
	unwanted functionalities	
Search results display	hits insufficiently described	
	layout problems	
	missing functionalities	
Labeling systems (Controlled Vocabularies)		
labels for headings		
	unrepresentative headings	Label does not stand for the content below it
labels for Metadata attributes / values		
labels for navigation elements		
	inconsistent label use	One label is used for different concepts, one concept is described with different labels
	misleading labels	label evokes wrong associations, user is sure what he finds under that link, but in fact there is something else; different label necessary
	non-predictive labels	Label is too unclear/vague, user cannot guess what might be behind it
labels for search thesaurus elements		

*Final Coding Guide for IA System Deficiencies¹⁷⁴ - Deficiencies for Content Providers
(partly in German)*

IA system component	Content provider problems	Definition and examples
Content framework		
Content scope		
	responsibility/ content/ constraints-dependent	Scope nach eigenen Bedürfnissen gewählt, Content gibt Scope vor; politische/juristische Verantwortlichkeit erlaubt hier keine Anpassung Content Scope von Webmaster vorgegeben / vorge-schlagen (evtl. weglassen)
	need for user-focus, unclear user needs	Content Scope an Bedürfnisse der User anpassen; die Bedürfnisse der User zu gewünschtem Scope ist un-klar, Input dazu ist hilfreich, Feedback genutzt
	need for restricted user access to content	
Content granularity		
	responsibility/ content/ constraints-dependent	Keine Abstriche möglich, Content diktiert Detailtiefe, eigene Verantwortung notwendig (Fach/Detailwissen) Zeit/Geldmangel diktiert Detailtiefe (Drag&Drop von abstracts etc.) Content von Webmaster in der Tiefe/Flachheit nicht akzeptiert
	need for user-focus, unclear user needs	Entscheidend: User-Bedürfnisse, (für User) notwendige Detailtiefe unbekannt, ins Blaue geschossen
Content wording		
	responsibility/content/ constraints-dependent	Wording nach eigenen Bedürfnissen gewählt, Content gibt wording vor; politische/juristische Verantwortlichkeit, Zeit/Geld erlaubt hier keine Anpassung; Wording mit Webmaster abgesprochen/vorgegeben, von oben vorgegeben
	need for user-focus, unclear user needs	Wunsch, Wording, soweit möglich, den Bedürfnissen der User anpassen; die Bedürfnisse der User zu ge-wünschtem wording ist unklar, Input dazu ist hilfreich, feedback genutzt
Content media type		
	responsibility/content/ constraints-dependent	Media type nach eigenen Bedürfnissen gewählt
	need for user-focus, unclear user needs	Media type an Bedürfnissen der User auswählen
Content functionality		
Organization systems		
Metadata systems (incl. attributes, Content Type Classes)		
	constraints (time/money) impede classification	keine Zeit/Geld dafür, nur was unbedingt nötig, nur schnell(&damit schlecht), auch Aktualisierung / An-passen von Metadaten über die Zeit sehr zeit/kostenintensiv Wenig genutzt, übersehen, einfach header kopiert
	missing attributes	Weitere Attribute gewünscht / notwendig
	unwanted attributes	Einzelne Attribute nicht notwendig/ nicht relevant (aus Sicht des Editors!); nur (subjektiv) relevante Attribute genutzt; damit auch nicht benutzt, oder über Webmas-ter erledigt;
	need for Content Type	(different sets of metadata attributes for specific con-

¹⁷⁴ In line with IA System Model V0.2

	Classes	tent types) Fehlende CTC, verschiedene Objekt-Typen vorhanden, die auch verschiedene Sets von Attributen benötigen
	inadequate distinction mandatory/optional	Unterscheidung mandatory / optional nicht in Ordnung
	inadequate formats for single attributes	Format für Attribute muss stimmen
Value Range (VR)	missing VR	CV fehlen für bestimmte Attribute, wären erwünscht, vorhandene werden wertgeschätzt, Freitexteingabe nicht ideal (Zeit/Geldmangel); auch: von Webmaster als Vorteil eingeschätzt, aber nicht mgl.; Konsistenz als Vorteil (auch über verschiedene Sprachen) Wunsch nach automated classification/defaulting, damit auch CV notwendig
	unwanted VR	CV überflüssig für bestimmte Attribute, eher hinderlich, zu komplex; besser Freitext, oder wenn dann eher unspezifisch
	missing values for an attribute (non-exhaustive)	Werte für ein Attribut zu wenig, Reste-Wert notwendig
	too finely grained value range	Werte für ein Attribut zu viel, zu fein gegliedert; auch: von Webmaster Zahl der Werte einfach gesetzt; auch: "hier nicht zu viele" -> zu viele kann ein Problem darstellen
	need for being able to propose missing values	CV-Neupropagierung von Werten möglich
	need for multi-selection	CV-Mehrfachauswahlen notwendig
Content structure		
	hierarchy too deep	zu tief geschachtelt
	inadequate location regarding own requirements	Anforderung, dorthin zu kommen, wo vermutet wird, dass die User das Thema suchen eigene, inhaltliche Anforderung, wo in der Struktur der Inhalt zu liegen kommen soll Inhaltliche Kategorisierung politisch nicht durchsetzbar
Criterion	inadequate criterion	Falsches Kriterium, anderes Kriterium gewünscht Anforderung: nur relevante Kriterien / bestimmte Kriterien gefordert (auch Mehrdimensionalität gefordert) Anforderung: optimale Anzahl von Kriterien (zu nur relevante Kriterien)
	instable categorization	Anforderung: Konstanz der Struktur ist gewährleistet
	unclear allocation of responsibilities	Criterion doesn't allow for clear allocation of responsibilities Anforderung: klare Aufteilung der inhaltlichen Verantwortlichkeit
Categories	missing categories (not exhaustive)	Kriterium ist nicht erschöpfend, Kategorien fehlen, Reste-Kategorie notwendig (exhaustiveness) keine passende Kategorie
	too coarsely grained category range	zu grob unterteilt / zu unspezifisch
	too finely grained category range	too fine grained, zu viele unbrauchbare Kategorien
	need for multi-selection	Anforderung: Mehrfachkategorisierungen erforderlich
	need for being able to propose missing categories	neue Kategorien erstellen können
Layout (page organization)		
	responsibility/content/constraints-dependent	Responsibility (political/legal)/ content / constraints (time/money) determine layout
	need for user-focus, unclear user needs	

	unwanted/missing page elements	Too much / too few page elements
	not enough screen space for single page elements	Not enough screen space for single page elements regarding own requirements, webmaster-defined screen space is not sufficient
	resulting layout not consistent with previewed layout	
Navigation systems		
Embedded navigation systems		
Global/local navigation		
Contextual navigation	need for contextually linking content	Wunsch nach Erstellen von Querverlinkungen
Supplemental navigation systems		
Guides/wizards		
Site maps/TOCs		
Indexes	constraints (time/money) impede indexing	Anforderung, Begriffe für den Index zu liefern, unter Zeit/Gelddruck nicht mgl.
	need for adequately incorporating content in an index	Wunsch, in einen zentralen Index aufgenommen zu werden
Search systems		
Search engine		
Search zones / search fields		
Search thesaurus		
Search interface		
Search query input		
Search results display		
Labeling systems (Controlled Vocabularies)		
labels for headings		
labels for Metadata attributes / values		
	unclear scope of attributes	einzelne Attribute unklar, auch wenig Ahnung, was bei Freitexteingaben eingetragen werden soll
	unclear scope of values	values not mutually exclusive Werte für ein Attribut nicht trennscharf genug, unklare Bedeutung der Werte
	unclear scope of categories	präzise Definitionen von Kategorien fehlen not selective enough categories, overlapping categories (mutually exclusiveness)
labels for navigation elements		
labels for search thesaurus elements		
	(see Metadata systems)	

Appendix B-1.3: Step 1.2: Preliminary Definitions of IA System Components

IA system component	Definition
Content framework	Characteristics of the content (information and applications) that the site is offering the end user
Content scope	The area of content that is covered by the site.
Content granularity	The level of detail in which the content is offered by the site.
Content wording	The manner in which the content is expressed in words (language, language level...)
Content media type	The means of communicating content and the technical format in which the content is

	delivered.
Content functionality	The amount of interactivity delivered with the site's content. Not included here is navigation and search.
Organization systems	Arrangement of content elements into a whole of interdependent parts
Metadata systems (incl. attributes, Content Type Classes)	A Metadata system is a description scheme for content consisting of one or more sets of Metadata attributes with respective value ranges. Each defined set forms a Content Type Class.
Value Range (VR)	Set of valid terms for a specific metadata attribute
Content structure	Content structure is the aggregate of content categories in their relationships to each other.
Criterion	A property (i.e., attribute) of the content which is used as a basis for developing the content structure.
Categories	A Category is a class with defined relationships to other classes. A Class is a container for content elements all sharing the same value of an attribute.
Layout (page organization)	A layout defines the arrangement of page elements (content-, navigation-, and interface elements)
Navigation systems	Navigation systems provide the end user a means to access information by selecting one of several offered navigation choices leading to a subset of the content
Embedded navigation systems	Navigation systems that are integrated in the actual pages of a site
Global/local navigation	Global navigation includes all navigation choices that are present on every page throughout a site. It allows users to browse hierarchically among content areas, and access supplemental content (help, search, ...). Local navigation includes the sub-navigation choices of one item of the global navigation; therefore, local navigational elements change between content areas; they allow users to browse hierarchically within a content area.
Contextual navigation	Contextual navigation includes additional navigation choices within a page of a site, similar to a cross reference. The linked content has not necessarily been grouped with the viewed content.
Supplemental navigation systems	Navigation systems that require extra pages to be shown to the user
Guides/wizards	A structured series of dialogs that ask questions and use these answers or choices to produce a result.
Site maps/TOCs	A site map graphically represents the levels of the site hierarchy. It provides a condensed overview of and links to major content areas and sub-sites within the site, usually in outline form.
Indexes	An index includes an alphabetical list of links to the contents of the site
Search systems	Search systems provide the end user a means of accessing content by executing a search query against an index of the content
Search engine	Software that provides full text indexing and searching capabilities.
Search zones/ search fields	A search zone is a subset of site content that has been separately indexed to support narrower searching (e.g., searching the tech support area within a software vendor's site). A search field is an attribute of the content separately searchable (e.g., the author's name)
Search thesaurus	A thesaurus that is used for query operations in a search engine to handle synonyms, variants, or misspellings
Search interface	
Search query input	The means of entering a search query
Search results display	The means of presenting content that matches the user's search query
Labeling systems (Controlled Vocabularies)	A defined set of labels.
labels for headings	The terms used in a heading for representing the information that follows it
labels for Metadata attributes / values	The terms used as a metadata attribute or as the values of such an attribute (in an indexing thesaurus), which each should represent the content that is described by it
labels for navigation elements	The terms used as navigation choice which should represent the content it links to.
labels for search thesaurus elements	The terms used as preferred term, and the terms used as variants, acronyms... of this preferred term (in a searching thesaurus that is used for exploding a user's query), which should represent the concept that is described by the preferred term.

Appendix B-1.4: Step 1.4: Detailed IA System Components Dependencies

Detailed Internal Dependencies Between IA System Components¹⁷⁵

IA system component	...has impact on ...	Description of impact	Example (concrete impact for website about wine)
Content framework¹⁷⁶			
Content scope			
	Content granularity	The range of possible content granularity levels is determined by characteristics of the content scope: a fine granularity is only possible when the scoped content is available in that detail	Content scope 1: "our products": levels of granularity range from high-level description of wines to more detailed information about single facets of a wine (e.g. region, winery,...); in any case, might not include e.g. info about the chemistry of a grape, also because the information is simply not available for the wines offered Content scope 2: "the art and science of distilling wine": the range of granularity levels ranges from very coarse descriptions of the process of winemaking to very detailed, scientific articles focusing on specific aspects; might include e.g. info about the chemistry of a grape
	Content wording	scope of content impacts which language level is necessary	Content scope 3: legal issues on distilling wine: these laws are specifically worded, no other wording is possible if this is the scope
	Content media type	Content scope limits potential media types	Content scope 1: portray wines offered -> text and images of wines: pdfs, html, gifs, jpeg; Content scope 2: art&science of distilling wine -> lesson on characteristic movement and behavior of high-quality wine in a wine glass: .mpg,
	Content functionality	Content scope impacts potential functionality	Content scope 1: sell wines: submit orders Content scope 2: art&science of distilling wine -> lesson on characteristic movement and behavior of high-quality wine in a wine glass: download video files from the web site
	Metadata systems	Content scope determines Content Type Classes necessary Content scope determines adequate metadata attributes Content scope determines adequate metadata attribute value ranges	Content scope 1: sell wines: Classification of different wines, attributes: region, winery, color; CTC: white vs. red wines Content scope 2: art&science of distilling wine: classification of information about distilling wine, attributes: information area, author...; CTC: info about methodology vs. info about chemistry...
	Content structure & Interaction flow	Content scope determines adequate content structure criteria Content scope determines adequate categories Content scope determines adequate	Content scope 1: sell wines: Content structure of different wines, criteria: region, winery, color Content scope 2: art&science of distilling wine: Content structure of information

¹⁷⁵ Read: IA system component (first column) has impact on IA system component (second column), which can be described as (third and fourth column); this input was given by (fifth column)

¹⁷⁶ Content scope 1: online winery, selling a variety of wines
Content scope 2: the art and science of distilling wine
Content scope 3: legal issues on distilling wine

		content structure	about distilling wine, criteria: information area, author...
	Page layout	Content scope provides layout requirements	Content scope 1: sell wines: layout for product catalogue: image, description of wine Content scope 2: art&science of distilling wine: layout for detailed information: more text, less images
	Supplemental navigation systems	Content scope determines if and which supplemental navigation tools are adequate/needed	Content scope 1: sell wines: alphabetical list of wineries, wizard for selecting a wine Content scope 2: art&science of distilling wine: alphabetical list of authors of scientific papers about wine distilling
Content granularity ¹⁷⁷			
	Content wording	the finer the granularity level, the more urgent the need for a higher language level	the more detailed the description of wines gets, the more urgent it is to use expert language: "tannin level", "body" instead of "taste" to describe a wine's character
	Metadata systems	the finer the level of granularity, the more detailed the MD attributes have to be to adequately describe the content	Content granularity 1: "Bordeaux" Content granularity 2: "Red wine/Red Bordeaux/Medoc/Margaux"
	Content structure & Interaction flow	the finer the level of granularity, the more detailed the content structure has to be to adequately describe the content	Content granularity 1: "Bordeaux" Content granularity 2: "Red wine/Red Bordeaux/Medoc/Margaux"
	Page layout	Content granularity determines layout requirements	Content granularity 1: layout has to fit to high-level description: color, taste, region Content granularity 2: layout has to fit to more detailed information: description of region, winery, winemaker, description of body, tannin level, grape, sugar level..
Content wording (e.g., "Sparkling wine" or "Champagne"?)			
	labels for headings	Content wording gives labels for headings	Already available content for a website uses the term "Champagne" instead of "Sparkling wine"; this acts as basis for the labeling system
	labels for Class/Cat	Content wording gives labels for metadata attributes	Already available content for a website uses the term "Champagne" instead of "Sparkling wine"; this acts as basis for the labeling system
	labels for navigation elements	Content wording gives labels for navigation elements	Already available content for a website uses the term "Champagne" instead of "Sparkling wine"; this acts as basis for the labeling system
	labels for search thesaurus elements	Content wording gives labels for search thesaurus elements	Already available content for a website uses the term "Champagne" instead of "Sparkling wine"; this acts as basis for the labeling system
Content media type			
	Metadata systems	Content media type gives values for respective metadata attribute	Business Reports about the wine industry in .pdf or video clips about wine making in .mpg; the technical format feeds the classification of content elements
Content functionality ¹⁷⁸			

¹⁷⁷ Catalogue of wines:

Content granularity 1: high-level description

Content granularity 2: detailed description of wines

	Content media type	Content functionality requires specific media type	Content functionality 2: compressed video format for easy download: .mpg
	Page layout	Content functionality requires additional page elements for existing page layouts or additional basic page layouts	Content functionality 1: basic page layout including a order submission form necessary Content functionality 2: basic page layout including video snapshots, download button necessary
	Embedded navigation systems	Content functionality requires additional embedded navigation elements	Content functionality 1: global navigation element "order wines" necessary
	Supplemental navigation systems	Content functionality requires additional supplemental navigation systems	Content functionality 1: wizard for check-out process necessary
Organization systems			
Metadata systems			
	Content structure & Interaction flow	Metadata systems feeds content structure: MD attributes can be used as content structure criterion, value ranges then define categories	Online shop for wines: MD attribute "region" serves for a content structure of all wines according to the region they come from
	Embedded navigation systems	Metadata systems feeds contextual navigation: what's related? [Lider & Mosoiu, 2003] Metadata systems can show alternative navigation paths [Lider & Mosoiu, 2003] keywords as contextual navigation [Wodtke, 2002, p. 129, p. 143]	Online shop for wines: for a specific wine, the MD attribute "region" gives contextual links to other wines from the same region
	Supplemental navigation systems	Metadata systems (attribute "keywords") feeds a dynamical generated alphabetical index [Rosenfeld & Morville, 2002 p. 88] Metadata elements can be used in wizard questions, e.g. in a search wizard: "what area do you want to search?" index terms (..) can serve as the source of a browsable list or menus (=index) [Rosenfeld & Morville, 2002, p. 88]	Online shop for wines: the MD attribute "winery that produced it" can be used to generate an alphabetical list of all wineries
	Search interface	Metadata systems allows for personalized search (all hits also accessible, access rights determine which hits are shown to the user)	Online shop for wines: for a specific wine, the MD attribute "can only be delivered in these countries" can be used to narrow down search results for wines that indeed can be purchased by the searcher
	Search engine	Metadata systems allows for implementation of search zones: fielded search (e.g., AUTHOR = ""), ; different indexes index terms support more precise searching than simple searching the full text of content - someone has assessed the content's meaning and described it using index terms, and searching those terms ought to be more effective than having a search engine match a query against the con-	fielded search: Online shop for wines: MD attribute "country" can be used to limit search results to wines from Italy Different indexes: different indexes for "wines" and "wineries" can be used to limit a full text search to only one of the areas

¹⁷⁸ Content functionality 1: submit orders
Content functionality 2: download video files from the web site

		tent's full text [Rosenfeld & Morville, 2002, p. 88] indexed content (tagged with keywords) is more likely to be found [Wodtke, 2002, p. 134]	
Content structure and Interaction flow			
	Embedded navigation systems	Content structure feeds global/local navigation a taxonomy as a front-end browsable Yahoo-like hierarch that's a visible, integral part of the user interface [Rosenfeld & Morville, 2002, p. 184, 192] a taxonomy is useful not only for searches, but also for effective browse hierarchies and for tying the two together [Wodtke, 2002, p. 138]	Online shop for wines: a content structure of wines according to the region they come from can be used to develop global/local navigation
	Supplemental navigation systems	Content structure feeds a dynamical generated, hierarchical site map	Online shop for wines: a content structure of wines according to the region they come from, which is used as a global/local navigation can also be used to develop a dynamical site map
	Search interface	Content structure allows for hits to be clustered into categories a taxonomy is useful not only for searches, but also for effective browse hierarchies and for tying the two together [Wodtke, 2002, p. 138]	Online shop for wines: a content structure of wines according to the region they come from can also be used to cluster results of a search for red wines into regions
	Search engine	Content structure allows for "search within this category" a taxonomy is useful not only for searches, but also for effective browse hierarchies and for tying the two together [Wodtke, 2002, p. 138]	Online shop for wines: a content structure of wines according to the region they come from, which is used as a global/local navigation can also be used to add a functionality "search within this region"
Page layout			
	Content granularity	layout determines content granularity	Online shop for wines: if a fixed layout defines a product page to be not larger than one screen, the level of detail for describing a wine is determined by that
	Embedded navigation systems	Layout determines number of navigation elements in global, local and contextual navigation	Online shop for wines: if a fixed layout defines the global navigation to be horizontal but not more than one line, then the number of global navigation elements is limited
	Supplemental navigation systems	layout determines index appearance Layout determines sitemap appearance Layout determines wizard appearance	Online shop for wines: a fixed page layout also defines the pages for an alphabetical index of wineries / sitemap / wizard for selecting wines
	Search interface	Layout determines search query input interface Layout determines search results display interface	Online shop for wines: a fixed page layout also defines the pages for the search query input page and the search results display page
	labels for headings	Layout determines labels for headings	Online shop for wines: a fixed page layout also defines rules for headings, e.g. number of words/letters possible
	labels for navigation elements	Layout determines labels for navigation elements	Online shop for wines: a fixed page layout also defines rules headings, e.g. number of words/letters possible
Navigation systems			
Embedded navigation systems			

	Metadata systems	Existing embedded navigation can determine Metadata systems: MD attributes and values ;	online winery: wines are navigated according to region, therefore the metadata system has to integrate an attribute "region" and respective value range to be able to mirror the navigation, e.g. for search engine results
	Content structure & Interaction flow	Existing embedded navigation can determine content structure and content structure criterion ;	online winery: wines are navigated according to region, therefore the Content structure is done likewise
Supplemental navigation systems			
	Metadata systems	Existing supplemental navigation can determine Metadata systems: MD attribute and value range ;	online winery: e.g. wines are navigated with an alphabetical index of winery names, therefore the metadata system integrates a MD attribute "winery name" with respective value range to mirror this navigation
Search systems			
Search engine			
	Search interface	option of giving more power and control to the user, asking them whether they'd like to use any combination of preferred, variant, broader, narrower, or associative terms in their query. [Rosenfeld & Morville, 2002, p. 195]	Online shop for wines: a search thesaurus can explode a search for "medok" to items with the correct spelling "Medoc" and all narrower items (Paulliac, Margaux)
	Metadata systems	the search options which the search engine should support (search zones) impacts what MD attributes should be in the database	Online winery: the search interface includes the functionality to limit the search for a wine to a specific region, therefore the search engine has to support this fielded search, therefore the set of MD attributes has to include region
Search interface			
	Search engine	search interface can be constructed to influence the way the search engine is accessed	Online winery: the search interface includes the functionality to limit the search for a wine to a specific region, therefore the search engine has to support this fielded search
Labeling systems (Controlled Vocabularies)			
Labels for headings			
	Content wording	labels for headings determine content wording an authority file can be a useful tool for content authors, enabling them to use the approved terms efficiently and consistently [Rosenfeld & Morville, 2002, p. 182] preferred items are a tool to internally control vocabulary [Wodtke, 2002, p. 147]	Online shop for wines: If content is created after a labeling system was fixed, the wording of the content should comply to the labeling system (e.g. always use "Champagne" instead of "Sparkling wine")
	Page layout	Labels for headings determine layout requirements	Online shop for wines: a pre-fixed labeling system (Red wines, rose wines - white wines) impacts layout design, i.e. the layout specifications have to allow for the use of that labels in headings
Labels for Metadata attributes/values			
	Content wording	labels for metadata attributes determine content wording	Online shop for wines: If content is created after a labeling system was fixed, the word-

			ing of the content should comply to the labeling system (e.g. always use "Champagne" instead of "Sparkling wine")
	Metadata systems	labels for metadata attributes labels for metadata attribute values indexing thesaurus for indexing content [Rosenfeld & Morville, 2002, p. 88, 193, 194] getting your pages to stand out from each other is a different and much more daunting challenge. That's where a more systematic approach to labeling (i.e., Classification) -using index terms from controlled vocabularies or thesauri- has more value [Rosenfeld & Morville, 2002, p. 90] preferred terms are a tool .. to inform you labeling process [Wodtke, 2002, p. 147]	The labeling system for "region" or "winery" are to be used in the respective MD attribute in the metadata system of wines
	Content structure & Interaction flow	labels for content structure criteria labels for categories	The labeling system for "region" or "winery" are to be used in the content structure of wines
Labels for navigation elements			
	Content wording	labels for navigation elements determine content wording	Online shop for wines: If content is created after a labeling system was fixed, the wording of the content should comply to the labeling system (e.g. always use "Champagne" instead of "Sparkling wine")
	Embedded navigation systems	labels for navigation elements in global, local and contextual navigation preferred items are also important as the user switches from searching to browsing mode [Rosenfeld & Morville, 2002, p. 183] a (searching) thesaurus can also provide greater browsing flexibility [Rosenfeld & Morville, 2002, p. 195]	The labeling system for "region" and "winery" are to be used for the respective embedded navigation systems
	Supplemental navigation systems	labels for navigation elements in wizards, indexes and sitemaps preferred items are also important as the user switches from searching to browsing mode [Rosenfeld & Morville, 2002, p. 183]	The labeling system for "region" and "winery" are to be used for the respective supplemental navigation systems
	Page layout	Labels for navigation elements determine layout requirements	Online shop for wines: a pre-fixed labeling system (Red wines, rose wines - white wines) impacts layout design, i.e. the layout specifications have to allow for the use of that labels in navigation elements
Labels for search thesaurus elements			
	Content wording	labels for search thesaurus elements determine content wording	Online shop for wines: If content is created after a labeling system was fixed, the wording of the content should comply to the labeling system (e.g. always use "Champagne" instead of "Sparkling wine")
	Search engine	Search thesaurus labels A searching thesaurus leverages a controlled vocabulary at the point of searching but not at the point of indexing [Rosenfeld & Morville, 2002, p.	The labeling system for "region" and "winery" are to be used in a search thesaurus to explode an incorrectly spelled search to the preferred term ("medok" to "Medoc")

		195] Google, however, recognizes the wide variety of spelling humans manage to invent, and although "chedder" works rather well, they graciously prompt you to try "cheddar" [Wodtke, 2002, p. 141]	
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Detailed External IA System Components Dependencies

Concept / Entity	...has impact on...	Description of impact	Example: website about wine
Internal components dependent from external entities:			
Business Strategy ¹⁷⁹			
	Content framework	Business requirements determine Content framework [Rosenfeld & Morville, 2002, p. 216] [Myers, 2002] [Rosenfeld, 1999]	Biz Strat 1: scope=descriptions of wines, functionality=order online, wording=plain to advanced language,... Biz Strat 2: scope: highly valuable quality knowledge about wine distilling; wording: expert language; media type: research papers as .pdf; functionality: download research papers, subscription forms
	Organization systems	Company Branding / Style Guides impact Layout Business goals/strategy drives organization of content: If you don't understand the goals and strategy of the business, how can you organize the content to further those business objectives? [Morville, 2000b] also: [Myers, 2002]	Biz Strat 1: layout should resemble print brochures already available; Classification: needs attribute "customer scope: novice, advanced, expert wine drinker" Biz Strat 2: layout has to support scientific, high-quality appearance: use layout standards from scientific research sites; Classification: attribute "shown before/after login", "description for pre-login appetizer text"; Categorization: two categorization structures necessary: before/after login
	Navigation systems	strategy impacts navigation system design [Rosenfeld & Morville, 2002, p. 108]; also: [Rosenfeld, 1999] [Myers, 2002]	Biz Strat 1: embedded navigation should include the main decision criteria for selecting a wine (food best associated with, price,...); contextual navigation should point to related products (crackers, wine glasses,...) also offered Biz Strat 2: embedded navigation should support scientific, high-quality appearance: stick to the scientific classification of wines; contextual navigation should point to related information (esp. in the after-login area)
	Search systems	Business strategy/goals determine if certain items are not shown in the search results to the searcher, or the ranking of results	Biz Strat 1: hide wines that are only available in Europe from U.S. searchers; rank according to price initially Biz Strat 2: show information, even if not available without login; rank according to relevancy only
	Labeling systems	Company Branding impacts choice of labels ; also: [Rosenfeld, 1999] [Myers, 2002]	Biz Strat 1: labels should resemble print brochure labels already available; Biz Strat 2: labels should support scientific, high-quality appearance: use expert language
Target User Group ¹⁸⁰			

¹⁷⁹ Biz Strategy 1: sell wine online

Biz Strategy 2: "The art & science of wine distilling": improve revenue from banner ads & subscription fees, make people browse through and subscribe to the site

	Content framework	Target User Group determines Content framework	TUG 1/2: scope: include crackers, recipes, dishes in offering; also give basic introduction to wines; wording: plain to advanced wording; functionality: tracking orders TUG3/4: scope: expert knowledge about wine-growing & distilling, hints & tricks (e.g. alternatives for use of pesticides,...); wording: expert wording; functionality: email-notification for news about a specific grape
	Organization systems	Target User Group (Content author) impacts Metadata systems / Content structure	TUG 2: offer condensed set of easily understandable MD attributes, give value ranges; only a minimum mandatory attributes TUG4: offer more detailed Metadata/Content structure, leave space for free-text input
	Navigation systems	Target User Group (End user) determines Navigation systems	TUG 1: offer navigation according to price, region, and taste TUG3: offer navigation according to established, scientific classification of wines
	Search systems	Target User Group (End user) impacts Search System Design	TUG 1: offer search according to price, region, and taste TUG3: offer search according to established, scientific classification of wines: tannine level, body, sugar level..
	Labeling systems	Target User Group determines Labeling systems	TUG 1/2: use plain to advanced language for labels TUG3/4: use expert language for labels
Content ¹⁸¹			
	Content framework	nature and volume of content already available impacts Content framework: We need to be aware of the nature and volume of content that exists today and how that might change a year from now.[...] Good information architecture design is informed by all three areas. [Rosenfeld & Morville, 2002, p. 23]	Content 1: scope/granularity/wording: information drawn from the print catalogue for each wine: price, region, description of taste,... Content 2: scope/granularity/wording: information drawn from the collection of articles, research papers and reports; media type: papers available in .pdf, reports as .doc,...
	Organization systems	nature and volume of content already available impacts Organization systems: We need to be aware of the nature and volume of content that exists today and how that might change a year from now.[...] Good information architecture design is informed by all three areas. [Rosenfeld & Morville, 2002, p. 23]	Content 1: Metadata systems: attributes drawn from the print catalogue for each wine: price, region, description of taste,... Content 2: Metadata systems: attributes drawn from the collection of articles: author, heading, abstract, year of publishing, magazine title, keywords..
	Navigation systems	nature and volume of content already available impacts Navigation systems: We need to be aware of the nature and volume of content that exists today and how that might change a year from now.[...] Good information architecture design is informed by all three areas.	Content 1: print catalogue navigation systems (e.g. alphabetical index of regions and respective wines, embedded navigation according to countries) inform online navigation system Content 2: collection of articles suggests alphabetical list of magazines, of authors; embedded navigation in articles rather according to topic

¹⁸⁰ Target User Group 1: End user = casual and regular wine drinkers;

Target User Group 2: Content authors = non-professional writers

Target User Group 3: End user = wine-makers, experts on wine-distilling;

Target User Group 4: Content authors = researchers/experts on wine-distilling

¹⁸¹ Content 1: print catalogue of wines available off-line

Content 2: collection of articles, research papers, reports about wine-growing and distilling

		[Rosenfeld & Morville, 2002, p. 23]	(e.g. use of pesticides) than to the kind of wine referred to in the articles
	Search systems	Content is used by the search engine to built up a search index [Rosenfeld & Morville, 2002, p. 135]	Content 1: search index including the attributes drawn from the print catalogue for each wine: price, region, description of taste,.. Content 2: search index including the attributes drawn from the collection of articles: author, heading, abstract, year of publishing, magazine title, keywords..
	Labeling systems	nature and volume of content already available impacts Labeling systems: We need to be aware of the nature and volume of content that exists today and how that might change a year from now.[...] Good information architecture design is informed by all three areas. [Rosenfeld & Morville, 2002, p. 23]	Content 1: labels drawn from the print catalogue, used for heading (e.g. name of wine), navigation, and class/cat labels (e.g. "area" or "region"?) Content 2: Classification: attributes drawn from the collection: heading labels: article headings; classification labels: "author", "abstract", "year of publishing"; navigation labels: "keywords", magazine titles,..
Content Management¹⁸²			
	Content Framework	Constraints: staffing, depth of in-house/freelance talent, etc. [Myers 2002]	CM 1: unprofessional authors, not capable of delivering content with adequate scope, granularity, wording CM 2: professional authors, capable and willing to deliver content with adequate scope, sufficient granularity and correct wording
	Organization systems	Content Management policies and technologies impact the use of Classification / Categorization systems in content authoring (e.g. use of MD, CVs) Responsibilities for content defined in CM may affect adequacy of Metadata systems	CM 1: metadata & CVs (e.g., "region" with an hierarchical list of regions) cannot adequately be integrated in the CMS, authors are not trained to correctly submit MD data (e.g. do not know how to choose keywords properly) CM 2: CMS can integrate MD and CVs, authors are capable, willing and paid to execute high-quality class/cat of content
	Content	Content Management delivers rules (e.g., policies, procedures, standards), roles (people who perform the management) and resources (e.g., time, money, software) used to author, edit and publish content objects for a site.	
System Development (SD, also: Information Technology, IT)			
	Organization systems	1. IT implements metadata system in a database [Rosenfeld & Morville, 2002 p. 135] [Myer 2002] 2. IT provides a metadata registry to support distributed tagging [Rosenfeld & Morville, 2002, p. 217] 3. IT provides automated classification / categorization tools [Rosenfeld & Morville, 2002, p. 217] Technology involves knowing how to move a developing site to the most effective and efficient playback environment, as well as figur-	Online winery: SD sets up a server with a product database, where for each wine available (=record) the MD attributes are stored (fields in the database)

¹⁸² Website for the art & science of wine distilling:

CM 1: low-tech CMS, scarce and low-quality resources, few rules/responsibilities, inadequate staffing of roles

CM 2: high-end CMS, sufficient and high-quality resources and rules/responsibilities, adequate staffing of roles

		ing out related backend mechanics (cgi, etc.).IA has to do with developing a framework for the site (its structure, labels, navigation, and content) that will enable users to manage and, ideally, exploit the site's content. [Rhodes, 2001b]	
	Navigation systems	1. Automated generation of browsable indexes (using MD "keywords") [Rosenfeld & Morville, 2002, p. 218] 2. technical implementation aspects (e.g. frames, browser navigation features) impact navigation system design [Rosenfeld & Morville, 2002, p. 108, 120]	SD / technical implementation leads to an unavailability of the browser-"Back" functionality; therefore, the navigation system should be able to compensate this, e.g. with a breadcrumb-functionality
	Search systems	support of a search thesaurus is dependent on the search engine's capabilities [Rosenfeld & Morville, 2002, p. 218] flexibility of the search engine determines search system options [Rosenfeld & Morville, 2002, p. 218] Query operations by the search engine can use the search thesaurus [Rosenfeld & Morville, 2002, p. 149] Technical aspects (e.g. search engine configuration) is IT, but IA can contribute know-how regarding how a search engine benefits users [Rosenfeld & Morville, 2002, pp. 136] display of results is dependent on the ranking algorithm applied by the search engine [Rosenfeld & Morville, 2002, p. 154] IA implements MD systems in a database for fielded search [Rosenfeld & Morville, 2002, p. 135]	SD / configuration of the search engine supports the functionality of a search thesaurus, where "Sparkling wine" is listed as a variant term for "Champagne"
	Content Management	SD delivers the necessary technical resources for CM	SD delivers hardware for the CMS, configures CMS
UID / Interaction / Graphic Design			
	Organization systems	Visual Design fleshes out layout Graphic Design is not IA [Rosenfeld & Morville, 2002, p. 9] The design of navigation systems takes us deep into the gray area between information architecture, interaction design, information design, visual design, and usability engineering [Rosenfeld & Morville, 2002, pp. 108]	Online winery: Graphic design (e.g. logos, graphics, photos,...) impacts layout of the pages
	Navigation systems	UID design impacts navigation system design [Rosenfeld & Morville, 2002, p. 108]	Online winery: Graphic design (e.g. logos, graphics, photos,...) determines final layout, therefore also how much space is left for global navigation elements, therefore the number of

			elements is constrained
	Search systems	UID design impacts search interface design	Online winery: Graphic design determines final layout, therefore also how much space is left for display of search results; Interaction Design determines detailed interaction of search functionality
External entities dependent from IA System components:			
Content framework			
	Content	Content framework sets the general conditions for the Content; existing content has to be compliant to the rules & guidelines of the CF; adaptation needed	Online winery: Framework defines content scope (description of wines offered), granularity (including short info about region, winery grape), wording (plain to advanced language), media type (gif-image of the bottle), functionality (online ordering, order tracking) of the content to be included; if missing, short infos about the region have to be added for each wine; if there are lengthy descriptions, they have to be shortened
	Content Management	Content framework yields basic reference points for the Content Management Process	Online winery: in setting up a CM process, the framework supports the definition of: scope, granularity, wording, media type of the content to be produced (=descriptions of wines to be offered)
	UID / Interaction / Graphic Design	Content framework delivers foundation for interaction design where necessary: functionality needed in integrated applications designed by interaction design	Online winery: the whole wine order process might be treated as a closed, integrated application whose functionality is designed by an interaction designer; content functionality then gives the basic functional requirements
Organization systems			
	UID / Interaction / Graphic Design	Layout sets general conditions for Graphics design: The information architect generally doesn't have much training in identity design, colors, layout, and certain forms of visual communication -- this is the expertise of the designer. [Morville 2000] Design encompasses artistic and technical elements-what the design should look like as well as which tool to use, when, and to what best aesthetic effect. .. IA has to do with developing a framework for the site (its structure, labels, navigation, and content) that will enable users to manage and, ideally, exploit the site's content. [Rhodes, 2001b]	Online winery: when designing a Order-page, IA might give a basic layout and the content elements to be included, then Graphic Design can define visual characteristics (e.g., color schemes, images & graphics) and Interaction Design the detailed interaction (e.g. in which sequence you move from one entry field to the next one)
	Content Management	Organization systems are to be used by the people assigned for content authoring/ editing/ publishing/.. in the CM process	Online winery: The authors of the content (descriptions of the offered wines) use the offered MD attributes and value ranges to adequately classify and categorize the content element
Navigation systems			
Search systems			
Labeling systems (Controlled Vocabularies)			

Appendix B-2: Step 2: IA Process Analysis

Appendix B-2.1: Step 2.1: Actual State IA Process Instances

IA Process Instances as Described in the Literature

#	Rosenfeld & Morville, 2002	Bailey, 1997	Fraser, 2002a	Fox, 2002	Veen & Fraser, 2001	Shiple, 1998	West, 1999	Ramsey, 2002	Zaudhaus LCC, 2003	Dijk, 2002	IconMedia lab Int. AB, 2002	O'Donnell, 2002	Info.Design Inc., 2002
1	1. Research Context: Background research, Introductory presentations, Strategy team meeting, Stakeholder interviews, Technology assessment, IT team meetings, CM team meetings	Shortcut #1: Identify Mission, Goals, Success metrics	1. User needs: interview users, analyze user tasks, create users' mental model	1. {Content inventory}	1. Initial discovery: business needs/ context [Kickoff: Meeting, Project Sponsor Interview, Stakeholder Group Sessions, Stakeholder one-on-ones, review of existing documentation]	1. Defining your goals: vision/mission of the organization, site goals, who are the intended audiences, why will they come to your site?	1. Define Your Goals: purpose/motive/driver factor of the site	1. Discovery: General project objectives, Client Domain (brand and business objectives), Knowledge Domain (terminology, standard processes, and general culture), User Domain (contextual inquiry or task analysis), Competitive analysis	1. Define: goals of the project, business objectives and directions	High level requirements workshop gets business goals, Initial functional requirements	{Business Concept} (from Business Strategy), {Marketing Plan} (from Business Strategy) Brand Identity (from Business Strategy)	1. Struktur und Organisation von Inhalten: Geschäftsziele des Anbieters vermitteln (vorgegebene Angebotspalette/Programmpolitik), Informationsbedürfnis der Kunden bedienen (Zielgruppenanalyse) Angemessenes strukturelles Design entwickeln	Phase 1: Envision (mission and vision for the site)
2	1. Research Content: Benchmarking, Heuristic evaluation, Content Analysis, Content Mapping	Shortcut #2: Establish a Consensus: critiquing competitor's sites	2. Content Matching: Content assets: Content inventory, Content map	2. {Unified content map}	2. Define the audience: examine target market data, previous research (competitive analysis, usability studies, log data) Form groups	2. Audience and competitors: Define the audience, Create scenarios, Competitive analysis	2. Gather information	2. Design work: Strategy (high-level concept) {creative brief}, Developing the site map {high-level structure}, Interface design sessions,	2. Conceive: {Task Analysis Diagram, Flow Diagram}, {sketches},	Think about the audience, user goals	Understand Context of User: Profile Target User, Research potential user needs	2. Etikettierung	Phase 2: Analyze: User Research

3	1. Research Users: Usage statistics-Clickstream-Analysiss Search log analysis Customer support data = Customer feedback data Surveys Contextual Inquiry = Field study Focus Groups Interviews Card Sorting User Testing	Shortcut #3: Develop a Wish List (Content & Functionality)	3. Compare User model and content Develop ideal IA	3. Classification scheme analysis	3. Task Analysis: User Interviews, Task Data Analysis, Mental Model Diagram	3. Site content: Identify Content and Functional Requirements {Content Inventory}, Group and Label Content	3. Organize the information: Divide information into groups, give each group a name	3. Documentation: {Style guides, Functional Specification review, Creative review	3. Design: {finished design ideas: Layout,..}	Defining success, estimated roadmap	Plan and Manage Content: Assess Content {Content Inventory}, Formalize Content Development Guide	3. Navigationssysteme entwickeln, Evaluieren von Testseiten mit Testpersonen, Index für Suchmaschine generieren	Phase 3: Design Evaluating content. Chunking (grouping) content. Testing content (labels) Revising content.
4	2. Strategy (incl. recommendations regarding: IA administration Technology integration Top-down or bottom-up emphasis Organization and labeling systems (top-down) Document type identification (bottom-up) Metadata field definition	Shortcut #4: Define the Audience; audience information needs	4. Business objectives: interview stakeholders, prioritize business goals	4. Content analysis	4. Content Model: Competitive Review Current State Research (Content, Architecture, Interaction, Technology), Content Model Diagram	4. Site Structure: Metaphor/Rationale Exploration, {Site Structure Listing / Blueprints}, {Global and Local Navigation}	4. Find a Balance that Communicates Your Goals		4. Implement: fine-tuning, testing, and perfecting the work	Data gathering and analysis: competitor analysis, existing market research, interviews, contextual inquiry, server log analysis, Card Sorting {Conceptual model: how users organize content}; High level audience analysis: who are they? What do they want from the site?; Detailed	Establish system scope: find actors and use cases, define system wide attributes, manage dependencies, prioritize use cases		Phase 4: Develop

	Navigation system design Content Management) {Metaphor exploration Scenarios Case studies and stories Conceptual Diagrams Blueprints and wire-frames Strategy report}									Task Analysis: what users do			
5	3. Design & Doc: {Blueprints Wireframes Content Mapping and Inventory Content Modeling Controlled Vocabularies Design Sketches Web-based Prototypes Architectural Style Guides}	Shortcut #5: Create a Content Inventory (incl. Content requirements, ownership)			5. Creating the product lens: Design basic structure of content	5. Align MM and Content	5. Visual Design: {Layout Grids, Design Sketches, Page Mock-ups, Web-based Prototype}	5. Find a Design that Presents Your Goals		Content Inventory {Content List}	Define requirements: detail a use case, structure the use case model, manage dependencies, review requirements		Phase 5: User Testing
6	4. Point-of-production architecture				6. {Site comparison tables}: aid in the migration and creation of content	6. Prioritize features		6. Backend issues		Prioritization exercise {roadmap with priorities}	Develop Information Architecture: Develop Sitemap, Develop Wireframes		Phase 6: Evaluate (formative & summative)
7					X. Stakeholder research	7. Design IA and Interaction diagrams and prototypes		7. (Visual) Design		Information Architecture Design {Wireframes, Functional requirements, Technical Specification}	Develop Creative Approach: Develop Visual System, Define Key Experiences, Forces,		

Appendix B-2.2: Step 2.2: Actual State IA Methods

Actual State IA Methods and Their Respective Benefits and Shortcomings

Method	Benefits	Shortcomings
Affinity Diagramming	<ul style="list-style-type: none"> ▪ simple ▪ powerful for grouping and understanding information ▪ provides a good way to identify and analyze issues. ▪ best used if the work can be followed up quickly 	
Best Practice/Competitive Analysis		
Card Sorting	<ul style="list-style-type: none"> ▪ Good for identifying user's view of the information space and differences between novice and expert users ▪ Can be done remotely ▪ Simple ▪ Well understood ▪ Cheap to use ▪ Quick to apply, which allows more users to be involved. ▪ Avoids directly asking users. ▪ Promotes users' buy-in to project ▪ Forces participants to bottom-up thinking and to also address less important items 	<ul style="list-style-type: none"> ▪ Users' models are not always the optimal solution ▪ Users often widely disagree in labeling categories ▪ Does not account for: business requirements, strategic directions, technical goals and limitations, and usability guidelines ▪ limits user to develop a single structure
Consolidated Assessment	<ul style="list-style-type: none"> ▪ Environment is more reflective of users' real-life activities; more 'lively and engaging' ▪ More meaningful results ▪ Improved efficiency (single logistics planning and recruiting, single test script, one findings presentation) 	
Content Inventory	<ul style="list-style-type: none"> ▪ detailed view of the site's content ▪ immeasurably important when synthesizing or re-architecting an overall content structure. ▪ vital to do if the site is not in a content management system 	<ul style="list-style-type: none"> ▪ tedious, ▪ time-consuming ▪ pure drudgery
Contextual Inquiry	<ul style="list-style-type: none"> ▪ Good for understanding the context of work, for learning about unknown domains ▪ Uncovers a wealth of invaluable data 	<ul style="list-style-type: none"> ▪ time-consuming
Critical Incident Technique		
Diary keeping	<ul style="list-style-type: none"> ▪ Allows data to be captured about every day tasks, without researcher intrusion 	<ul style="list-style-type: none"> ▪ Users may forget to complete their diary or fail to complete it properly if insufficient instruction is given
End User Feedback Analysis		
Field study	<ul style="list-style-type: none"> ▪ probably the truest and most accurate appraisals of usability since the actual user, product, and environment are all in place and interacting with each other. 	
Focus Group (group discussion)	<ul style="list-style-type: none"> ▪ Allows the analyst to rapidly obtain a wide variety of views from a range of 	<ul style="list-style-type: none"> ▪ Social factors such as peer pressure may lead to inaccurate reports or participants being in-

sion)	<p>people with widely differing but relevant perspectives</p> <ul style="list-style-type: none"> ▪ Help to summarize the ideas and information held by individual members ▪ Each participant can act to stimulate ideas in the other people present ▪ By a process of discussion, the collective view becomes established which is greater than the individual parts 	<p>hibited.</p> <ul style="list-style-type: none"> ▪ Some people may also not always think creatively in a group setting and prefer to be interviewed or to complete a survey form in their own time
Free Listing		
Functionality matrix	<ul style="list-style-type: none"> ▪ can be tailored to suit varying design processes and in-house styles. ▪ allows different user types to be considered together in a single process. ▪ Superfluous functions are identified. ▪ represents a reference in subsequent product lifecycle stages and may be updated in the light of prototyping ▪ allows for both seeing the big picture and the details ▪ physicality of paper and wall encourages conversation and collaboration 	<ul style="list-style-type: none"> ▪ prime focus is on functions and features rather than interface appearance. ▪ can be cumbersome for large numbers of functions ▪ can get out of sync if there are multiple versions ▪ large format printers are expensive
Interface Design Patterns		
Interview	<ul style="list-style-type: none"> ▪ Quick and cheap to carry out (particularly compared to observational methods) ▪ Promotes users' buy-in to the project ▪ Good for identifying areas which require more detailed analysis (exploratory studies) ▪ Yields a wealth of data 	<ul style="list-style-type: none"> ▪ Not good for assessing actual behaviors ▪ What users say often depends on the skill of the interviewer, particularly when it comes to putting the users at their ease. ▪ Interviewer may need to acquire domain knowledge in order to know what questions to ask. ▪ Interviewers may put their own interpretation on what is said. ▪ Interviewees can have difficulty in articulating their concerns ▪ They may provide the answers that they believe are expected or that might win them favor. ▪ Writing interview notes up can be time consuming. ▪ Writing notes based on an audio recording is even more laborious.
Log File Analysis	<ul style="list-style-type: none"> ▪ Good for: ▪ creating user profiles, ▪ identifying user navigation patterns, ▪ predicting user behavior, ▪ comparing expected and actual web site usage, ▪ adjusting and personalizing web site to the interests of its users, ▪ supporting business / marketing decisions 	<ul style="list-style-type: none"> ▪ Privacy Issues ▪ Actual user behavior not observable ▪ Biasing factors: cache, aborted sessions, response delays, inadequate information presentation
Parallel design	<ul style="list-style-type: none"> ▪ Quick ▪ Cost effective ▪ Allows several approaches to be explored at the same time, thus compressing the concept development schedule. ▪ The concepts generated can often be combined so that the final system benefits from all ideas proposed. ▪ Only minimal resources and materials 	<ul style="list-style-type: none"> ▪ Requires a number of design team members to be available at the same time to produce system concepts. ▪ Requires a lot of time over a short period for the design work to be carried out. ▪ Time is also needed to compare parallel design outputs properly so that the benefits of each approach are obtained

	<ul style="list-style-type: none"> are required to convey product feel ▪ Little or no human factors expertise necessary 	
Participatory Design	<ul style="list-style-type: none"> ▪ Gives users a voice in the design process, thus increasing the probability of a usable design ▪ Enables technical and non-technical participants to participate equally ▪ Provides an opportunity for developers to meet, work with and understand their users ▪ Provides a forum for identifying issues ▪ Promotes user buy-in ▪ Highly productive ▪ Easily learned and applied 	<ul style="list-style-type: none"> ▪ Potential users can become too close to the design team, react and think like the others, or by virtue of their desire to avoid admonishing their colleagues, withhold important concerns or criticism
Prioritization exercise		
Prototyping		
Paper Prototyping	<ul style="list-style-type: none"> ▪ Good for collecting feedback, validating designs, identifying problematic issues early on ▪ Potential usability problems can be detected at a very early stage in the design process before any code has been written. ▪ Communication between designers and users is promoted. ▪ Only minimal resources and materials are required, thus minimizing reluctance to design iterations. ▪ Little or no human factors expertise necessary ▪ Cost effective ▪ Supports participatory design activities ▪ Distinct separation of design- and development activities, thus allowing for easy iteration 	<ul style="list-style-type: none"> ▪ Do not support the evaluation of fine design detail. ▪ Cannot reliably simulate system response times or be used to deliver metric data. ▪ The individual playing the role of the computer must be fully aware of the functionality of the intended system in order to simulate the computer.
Video Prototyping	<ul style="list-style-type: none"> ▪ Good for identifying problematic issues early on ▪ Provides a dynamic simulation of interface elements that can be viewed and commented on by both design teams and intended users. ▪ Minimal resources and materials required. ▪ little or no human factors expertise necessary 	<ul style="list-style-type: none"> ▪ Staff familiar with the functionality of the intended system are required to create the video prototype. ▪ The method does not actually capture a user interacting with the prototype. ▪ Do not support the evaluation of fine design detail.
Computer-based (Rapid) Prototyping	<ul style="list-style-type: none"> ▪ Permits the swift development of interactive software prototypes. ▪ High fidelity with the final product. ▪ Supports metric-based evaluations. 	<ul style="list-style-type: none"> ▪ Requires software development skills. ▪ More time consuming than paper-based approaches. ▪ Greater resources required ▪ Due to the greater investment in skills and time there may be reluctance to additional design iterations
Wireframe Prototyping	<ul style="list-style-type: none"> ▪ demonstrates a site concept quickly ▪ allows clients to react to content placement and rendering ▪ can provide guidance to visual designers with respect to information priorities ▪ allows for usability testing early in the project lifecycle 	<ul style="list-style-type: none"> ▪ hinders creativity and innovation by imposing (real or imagined) limits on design team ▪ distracts client from tasks at hand: evaluating page priorities, understanding information relationships ▪ is not necessarily HTML-ready if not developed to scale

	<ul style="list-style-type: none"> ▪ can elaborate on a singular vision for the site ▪ can facilitate collaboration between design team and information architects ▪ is easy for clients to understand 	<ul style="list-style-type: none"> ▪ is not necessarily HTML-ready if developed without "chrome" ▪ does not provide accurate usability testing results ▪ relies on other documentation to provide a complete picture ▪ does not consider color, typography, and other brand identity elements ▪ requires time to wrestle with layout details, which might change in final design anyway
Questionnaire	▪	▪
Scenarios	<ul style="list-style-type: none"> ▪ Good for describing a system interaction from the user's perspective, for removing focus from technology in order to open up design possibilities, and for ensuring that technical or budgetary constraints do not override usability constraints without due consideration. ▪ Allows for a holistic description of the user's experience ▪ Excellent communication tool – all humans understand stories ▪ Works well across multi-disciplinary teams ▪ Fleshes out persona's "existence" 	<ul style="list-style-type: none"> ▪ Not appropriate for considering the details of interface design and layout.
Storyboarding	<ul style="list-style-type: none"> ▪ Good for making a task flowchart meaningful, expressing discrete interactions ▪ Feedback can be gained on system functionality, style and also navigation options early on in the development cycle where changes can be more easily implemented. ▪ Quick and easy ▪ Minimal resources and materials required. ▪ Little or no human factors expertise necessary ▪ simple enough to not be mistaken for page designs; ▪ complex enough to provide a clear vision of what the site will be like ▪ The method promotes communication between designers and users. 	<ul style="list-style-type: none"> ▪ Can lack the interactive quality of other prototyping methods although interactive storyboarding systems are available. ▪ Do not support the evaluation of fine design detail. ▪ Do not accurately convey system response times ▪ Sometimes mistaken for actual design
Survey	<ul style="list-style-type: none"> ▪ Good for assessing users' subjective satisfaction, possible anxieties, reasons for visiting the site ▪ uses larger sample sizes than focus groups to generalize to an entire population ▪ Quick, simple, and relatively inexpensive to administer (but not to design). ▪ Results can be subjected to statistical analysis, yielding quantitative data 	<ul style="list-style-type: none"> ▪ Less apt for feedback on design ideas ▪ Biased responses ▪ Too much information from those who are coping with their jobs, and too little from those who aren't ▪ Cannot match the focus group in its ability to seek for in-depth responses and rationale ▪ Survey design is not straightforward and experienced guidance is needed. ▪ May be hard to follow up on interesting comments as it is often not desirable or possible to keep records of respondents.
Task Analysis	<ul style="list-style-type: none"> ▪ Provides knowledge of the tasks that the user wishes to perform. Thus it is a reference against which the value of the system functions and features can be tested. 	<ul style="list-style-type: none"> ▪ Formal task analysis can be time consuming and produce much data requiring considerable effort to analyze.
Task Allocation	<ul style="list-style-type: none"> ▪ Counteracts the tendency to try and 	<ul style="list-style-type: none"> ▪ Requires some concept of the new system for

charts	computerize the whole of a working system leaving users to carry out the remaining tasks regardless of the kinds of jobs this produces.	users to contribute to the process and generate new options.
Usability Context Analysis	<ul style="list-style-type: none"> ▪ Offers a framework to ensure that all factors which may affect usability are identified before design work starts. ▪ Context meetings bring together all the people relevant to a development program, early on in the project. ▪ It also helps to ensure that evaluation activities produce valid results, by specifying how important factors are to be handled in an evaluation, and by defining how well the evaluation reflects real world use. ▪ For comparative evaluations the method documents the circumstances of each evaluation (e.g. for comparisons between novice and expert groups of users). 	<ul style="list-style-type: none"> ▪ Success of this method depends upon competent chairing to keep the meeting focused on the relevant issues. ▪ Familiarity with the Context of Use questionnaire by the chairperson is essential. ▪ Context meetings can be difficult to arrange because of the number and type of people usually involved. ▪ Context meetings can be frustrating without competent chairing, and the key issues can be hard to identify.
(Usability) Inspection	<ul style="list-style-type: none"> ▪ Good when resource constraints do not allow usability testing 	<ul style="list-style-type: none"> ▪ Cannot substitute for usability testing
Heuristic evaluation	<ul style="list-style-type: none"> ▪ Provides quick and relatively cheap feedback to designers and an estimate on how much a user interface can be improved ▪ Results can generate good ideas for improving the user interface. ▪ Provides valid and useful results ▪ Can also be performed early on ▪ Checking conformity to established guidelines helps to promote compatibility with similar systems. ▪ Can guide further testing with users 	<ul style="list-style-type: none"> ▪ Usually identifies problems which are rather easy to demonstrate, while maybe missing other critical, but more hidden problems ▪ The method can seem overly critical as it is normally not used to identify the 'good' aspects. ▪ Can be very time-consuming to check conformance to voluminous written guidelines ▪ Relies on the expert's knowledge of those guidelines and his/her ability to identify non-conformances 'on-the-fly'. ▪ Quality of results depends on the capability of the experts who conduct the evaluation.
Guideline reviews		
Standards inspections		
Formal Usability inspection	<ul style="list-style-type: none"> ▪ Formalization improves efficiency of method 	
Consistency inspections		
Human performance models (GOMS)	<ul style="list-style-type: none"> ▪ Yields valid predictions ▪ Helps to discover usability problems not found by other methods and to reduce task execution time ▪ Can be economically advantageous to use such a predictive model ▪ Easy to construct a simple GOMS model ▪ Saves development time ▪ Saves the user time by reducing the learning time required to manipulate the system 	<ul style="list-style-type: none"> ▪ Three restrictions: 1. task must be representable in a procedural format., 2. can only represent routine cognitive skills, 3. the analyst must start with a list of top- level tasks or user goals ▪ GOMS's assumption of error-free performance is not adequate for novice users or leading edge technology systems ▪ Accuracy with respect to real users reduces with the level of granularity of the analysis performed
(Usability) Test		
Performance measurement		
Co-operative evaluation	<ul style="list-style-type: none"> ▪ Can detect usability problems early in the design process. ▪ Yields Information on the user's thought processes as well as their actions 	<ul style="list-style-type: none"> ▪ Can be very time consuming to analyze. ▪ The close involvement of designers in this evaluation technique makes it unsuitable in circumstances which require an independent

	<ul style="list-style-type: none"> ▪ Communication between designers and users is promoted. ▪ Little or no human factors training necessary 	assessment, such as quality assurance.
Wizard of Oz technique		
Perceived IA Test	<ul style="list-style-type: none"> ▪ Good for understanding users' view of the site and its information architecture ▪ Focuses on the user's subjective interpretation of how the site is structured ▪ Participants can use several modalities can to express their view 	<ul style="list-style-type: none"> ▪ Participants might only re-draw the actual structure, not their interpretation ▪ results are not very detailed
Structure evaluation	<ul style="list-style-type: none"> ▪ Simple ▪ Cost-effective ▪ Good for assessing if user find items in the structure ▪ Flexible to accommodate design changes ▪ does not require a full prototype ▪ yields "hard", quantitative data 	
Card-based classification evaluation	<ul style="list-style-type: none"> ▪ Quick ▪ Get people to participate easily ▪ Get a lot of participants ▪ Cover many scenarios and much of the classification. ▪ Change the classification as you go or test alternatives on the fly. ▪ Rerun the evaluation whenever you make changes. ▪ Gather valuable information about how people think. ▪ The wrap-up at the end is especially useful for getting additional feedback from participants. 	
User Profile Analysis/ Persona Development	<ul style="list-style-type: none"> ▪ Provides focus for the design ▪ Humanizes the design ▪ Effective for bringing user-centered design into an organization ▪ Helps to get past personal opinions and presumptions to understand what users truly need 	
Walkthrough	<ul style="list-style-type: none"> ▪ Good for testing gross navigation, for early and informal validation of design decisions, for feedback from several people at once, and when resource constraints do not allow formal testing. ▪ Flexible means of obtaining reactions, allowing the users' discussion to range over issues not originally considered. 	<ul style="list-style-type: none"> ▪ Requires some form of prototype to show and for user to react to. ▪ Results are opinions rather than objective data. ▪ Users may tend to react positively on seeing some prototype in operation. ▪ It may be difficult to imagine how the system will operate in the real environment ▪ A significant weakness of paper-based walkthroughs is the fact that they do not show interactive behavior.
Pluralistic Walkthrough	<ul style="list-style-type: none"> ▪ Good for early assessment of user performance and satisfaction ▪ Quick ▪ Cost-effective ▪ no prototype necessary ▪ with prototype, it allows for rapid test-retest iterations ▪ Allows for redesign on the fly ▪ yields results not achieved with testing methods 	<ul style="list-style-type: none"> ▪ Speed of the method is dependent on the slowest participant ▪ Only parts of the overall product are evaluated ▪ Even if several solutions are possible, only one is addressed

	<ul style="list-style-type: none"> ▪ Allows for rapid feedback and confirmation of issues from each of the three participating stakeholders ▪ Promotes user buy-in 	
Cognitive Walk-through	<ul style="list-style-type: none"> ▪ Identifies mismatches in the conceptualization of users, their tasks, wording, and inadequate feedback 	<ul style="list-style-type: none"> ▪ Only good for evaluating ease of use; cannot address ease of learning ▪ Identifies rather specific than general problems, might miss severe problems
Usability Walk-through	<ul style="list-style-type: none"> ▪ Detailed user feedback can be obtained quickly and at little expense. ▪ The feedback can be obtained on paper designs before significant development work is undertaken. ▪ The walkthrough meeting provides a mechanism to build rapport between users and members of the development team. 	<ul style="list-style-type: none"> ▪ Users may be too shy to speak their mind and offer criticisms. ▪ The paper designs which are typically used with this method may not be sufficiently detailed to enable users to appreciate how things will actually work in practice, so the feedback they give must be treated with care.
Workshop		
Brainstorming	<ul style="list-style-type: none"> ▪ The group process is usually perceived as rewarding in itself ▪ Creates a feeling of ownership of the result. ▪ In the brainstorming process, everybody in the group can take credit for the good ideas. ▪ It does not take long to obtain useful data and the session need not take more than one hour. 	<ul style="list-style-type: none"> ▪ Some studies show that people working in isolation produces more and better ideas than when working as a group.
Stakeholder meeting		

Appendix B-2.3: Step 2.3: Detailed IA Process Deficiencies

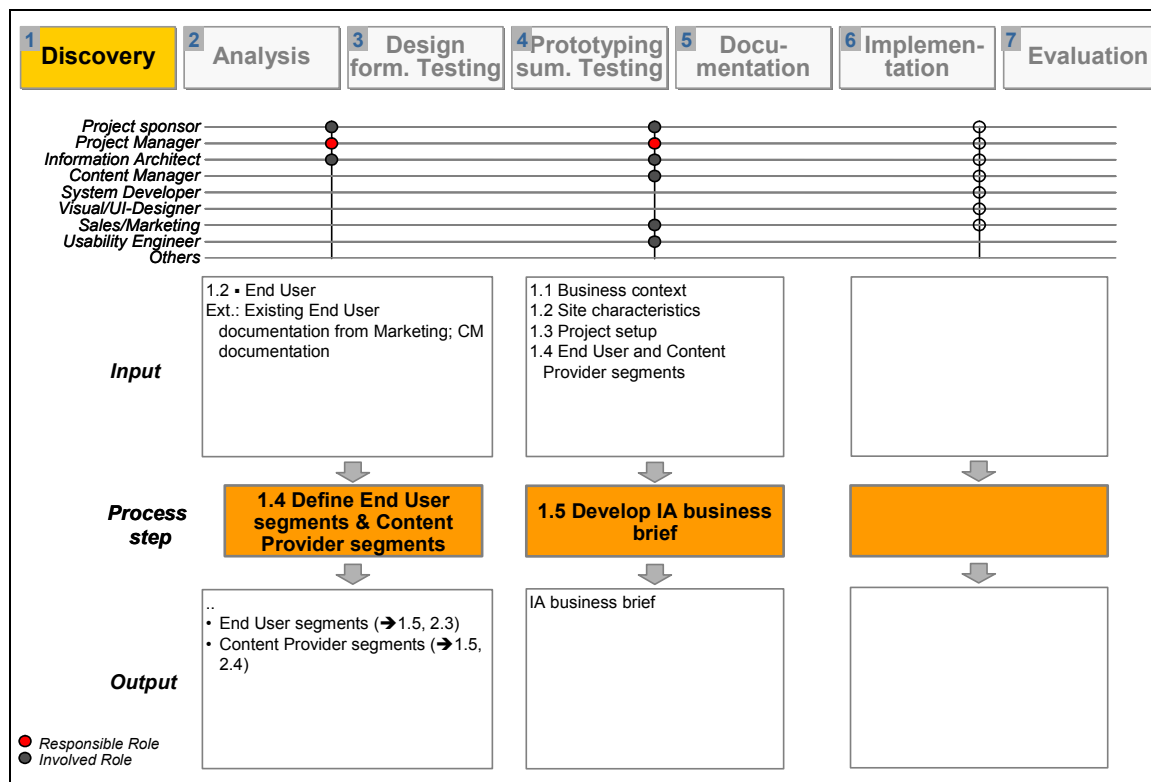
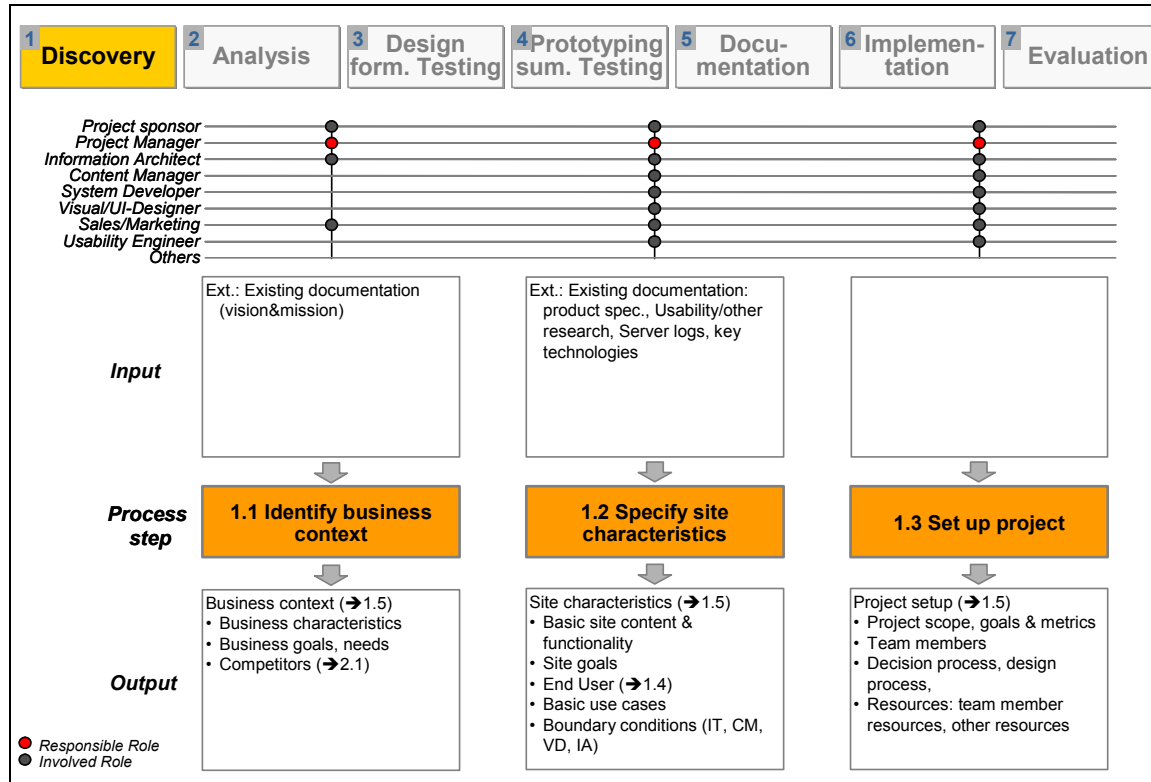
	IA system components & respective deficiencies ¹⁸³	IA Process Phase / Step																		Other Contributing Factors									
		1				2				3						4				5				6	7				
User Group: EndUser/ContentProvider		1.x Specify Biz	1.x Specify site goals	1.x Specify target audience	1.x Specify success metrics	1.x Set up coop. with stakeholders	2.x Perform Competitive Analysis	2.x Perform Content Analysis	2.x Perform End User Research	(2.x Perform CP Research)	3.1.x Align EU model & Content model	(3.1.x Align CP model & Content model)	3.2 Develop basic strategy	3.3 Prioritize Features	3.4.x Design IA	3.4.x Develop rec.: IA-Mnt, CM&SD	3.4.x Coop / Align with UID / VD	3.4.x Prototyping	4.x Perform Usability Tests	(4.x Perform CP review / UT)	4.x Perform VD Review	4.x Perform SD Review	5.x Develop: Arch. Style Guide	5.x Develop: Visual Style Guide	5.x Develop: CM Guide	5.x Develop: Func./ tech. Spec	Implement / consult IA impl.	Measure success (metrics)	
EU	Content scope		x					x	x		xx	xx	xx	xx	xx	x				x				x		x		x	missing CM training / controlling; inadequate CF design in 3.1, 3.2 & 3.4
	missing content, unwanted/outdated content		x					x	x		xx		xx		xx	x				x				x		x		x	missing CM training / controlling; inadequate CF design in 3.1, 3.2 & 3.4
CP	Content scope							x	x	x	xx	xx	xx	xx	xx	xx				x				x		x			
	responsibility/content/constraints-dependent							x		x		xx	xx	xx	x	xx					x				x				
	need for user-focus, unclear user needs								x	x		x				xx					x				x				
	need for restricted end user's access to content							x		x		xx	xx	xx	xx						x			x			x		
EU	Content granularity		x					x	x	xx	xx	xx	xx	xx	xx	x				x							x		inadequate CF design in 3.1, 3.2 & 3.5

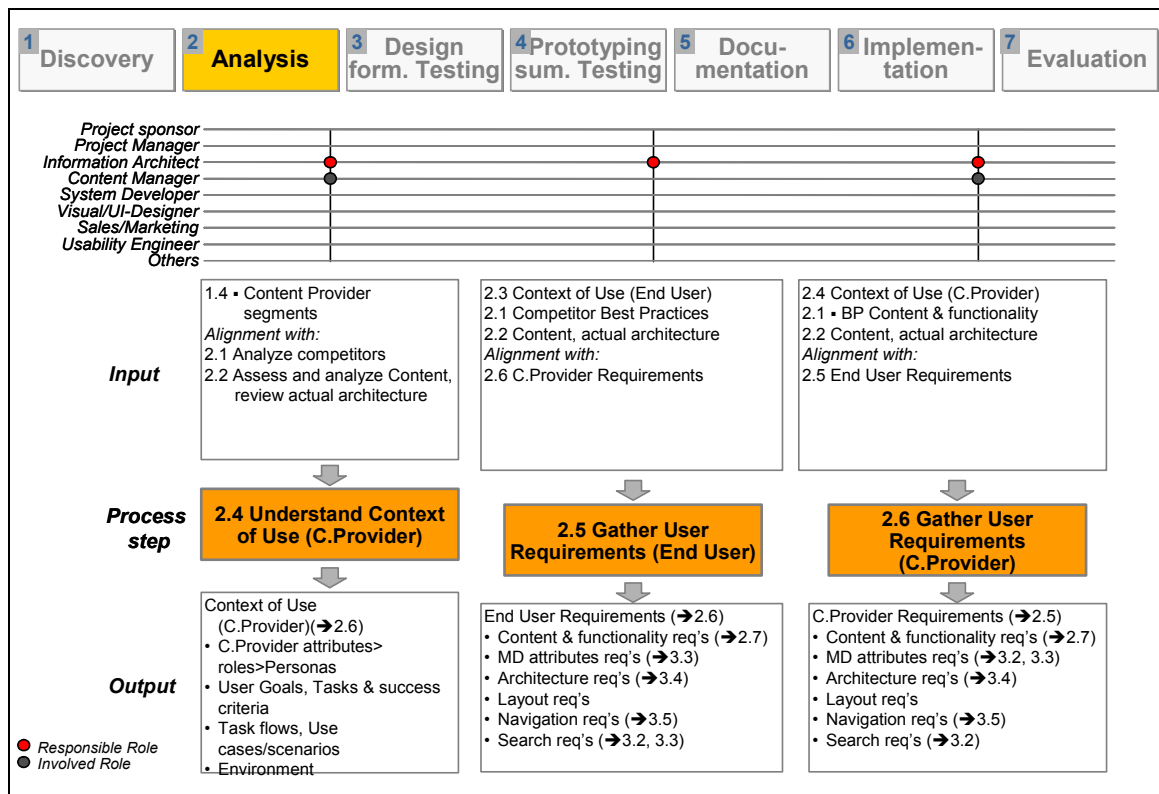
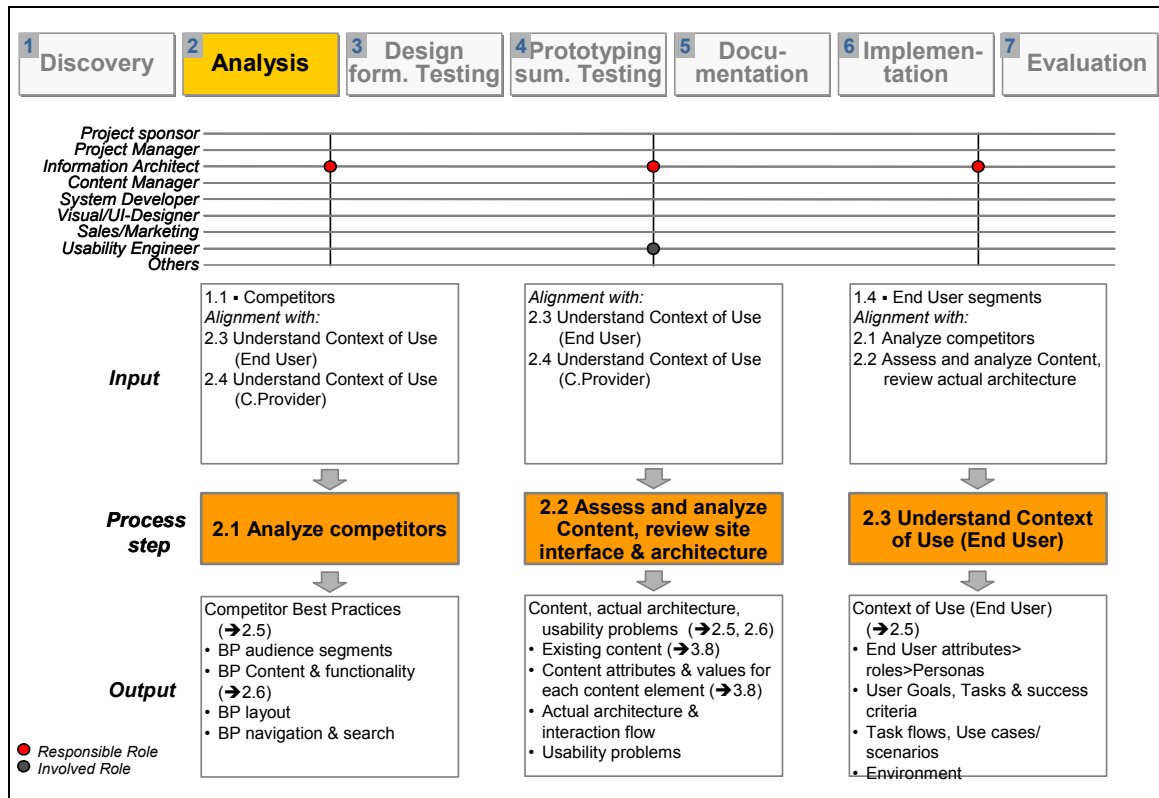
¹⁸³ Read: for each IA system deficiency reported by either end users (EU) or content providers (CP), IA process steps marked with x or xx can contribute to this deficiency.

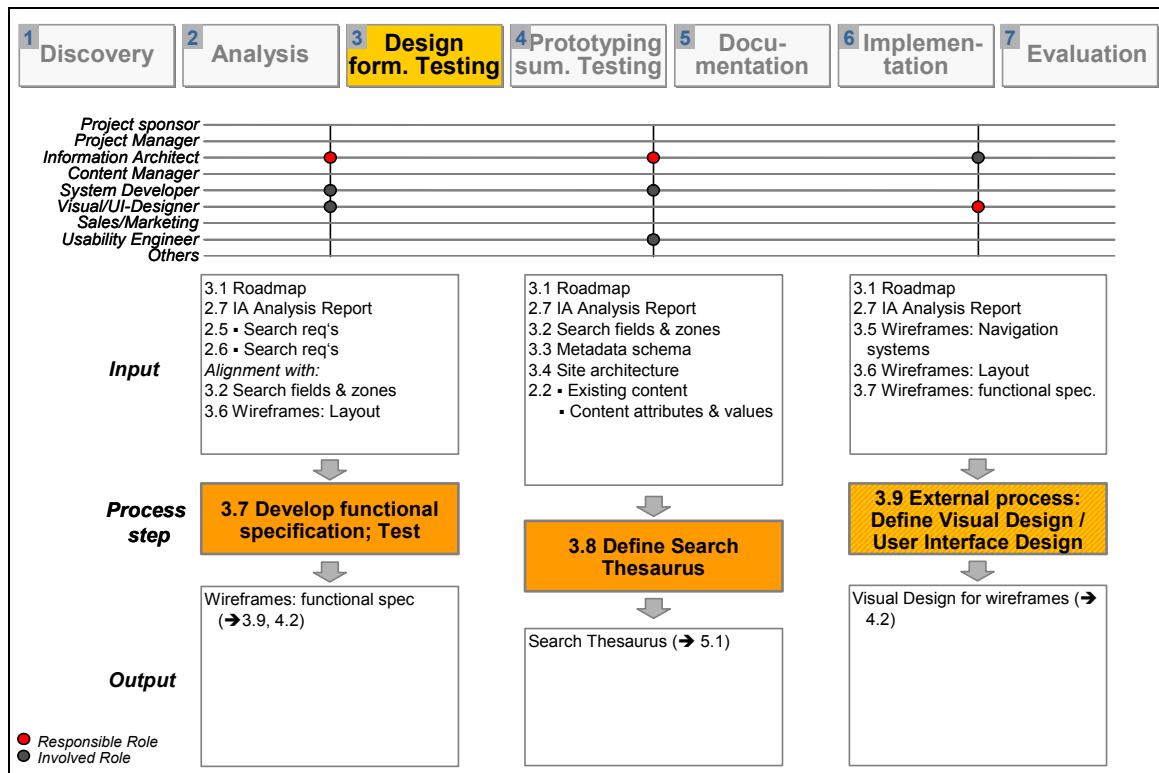
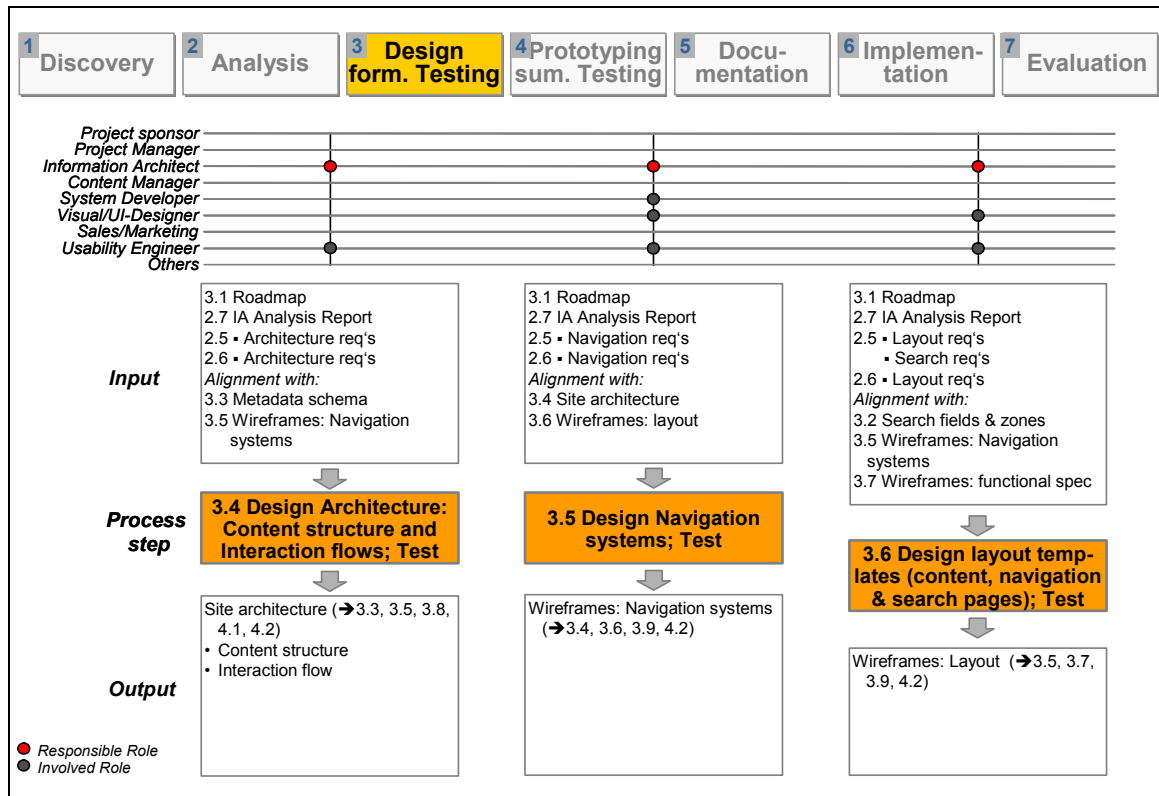
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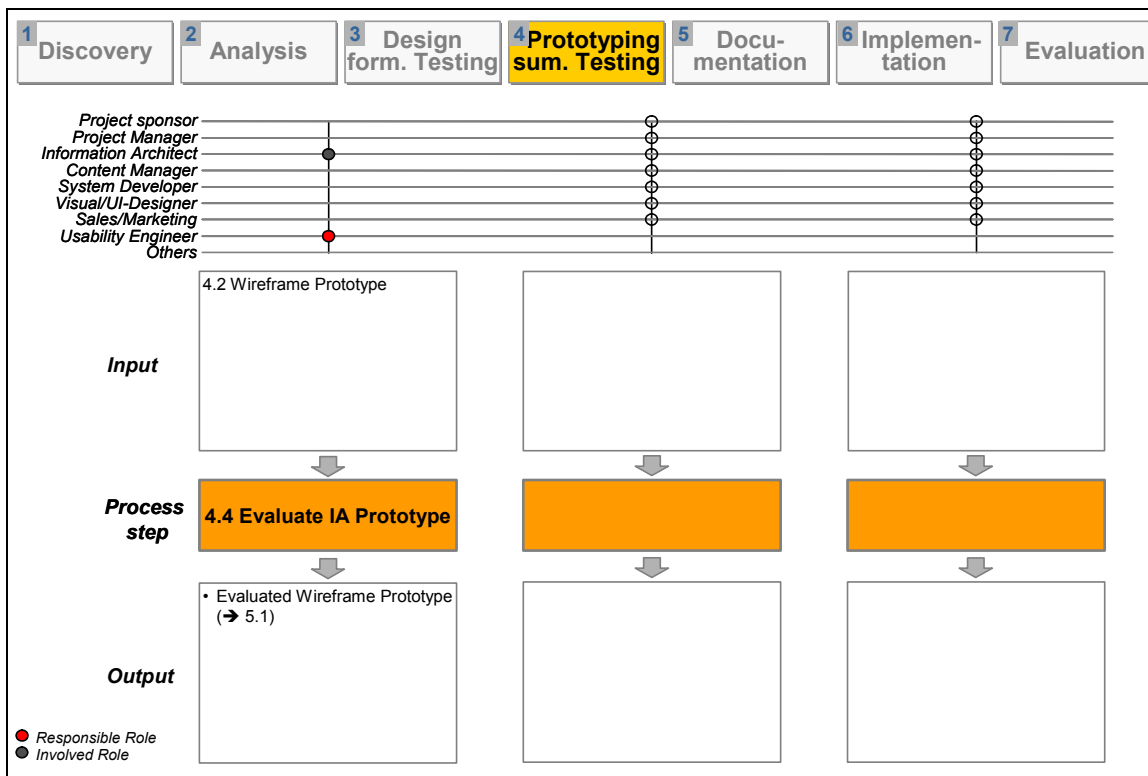
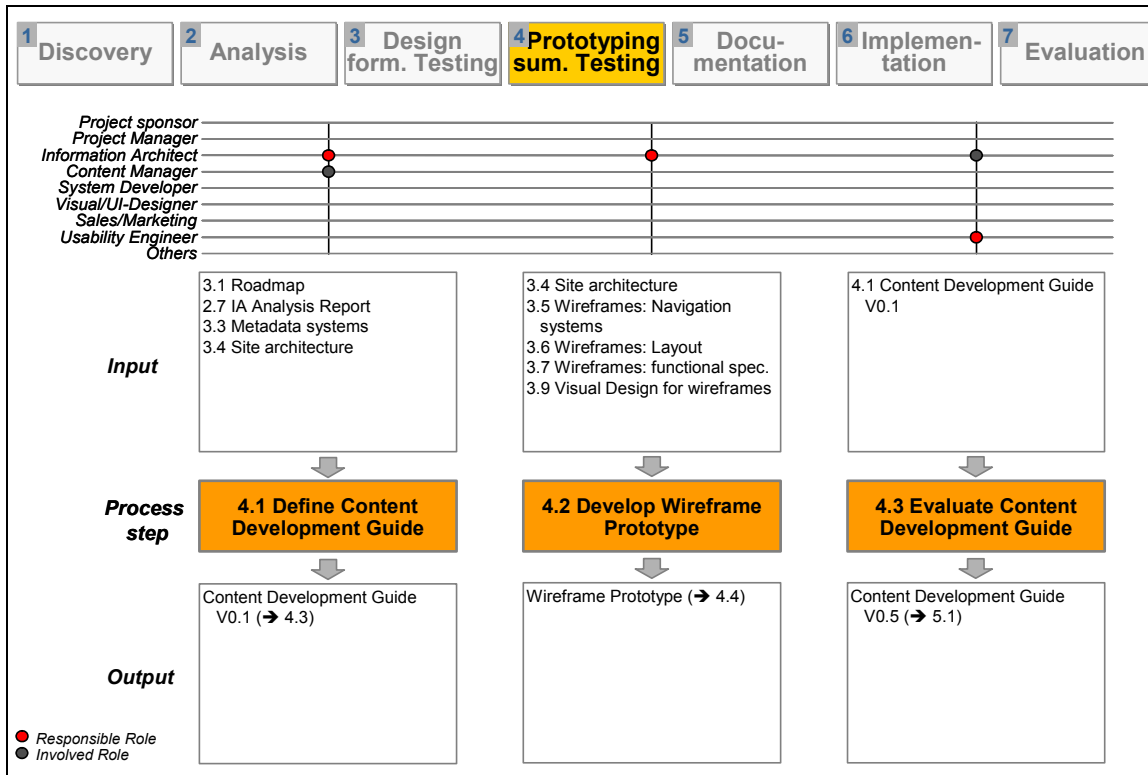
Appendix B-3: Step 4: Process Setup

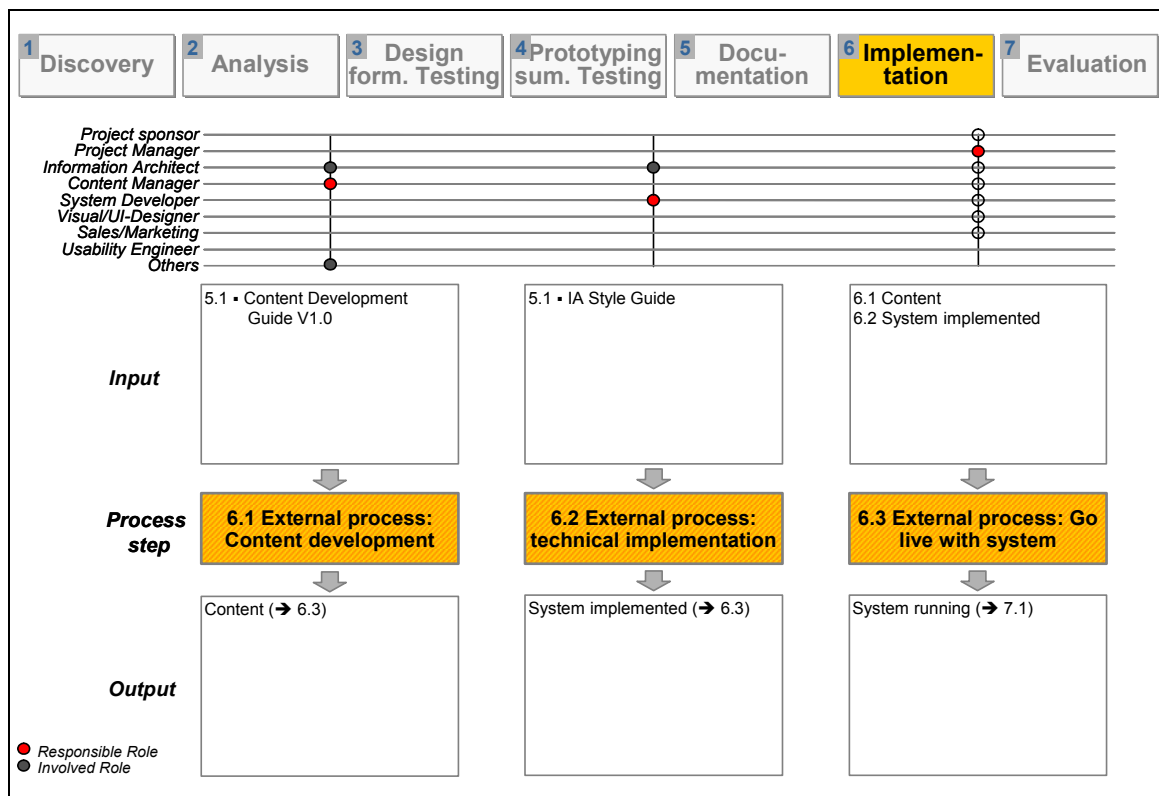
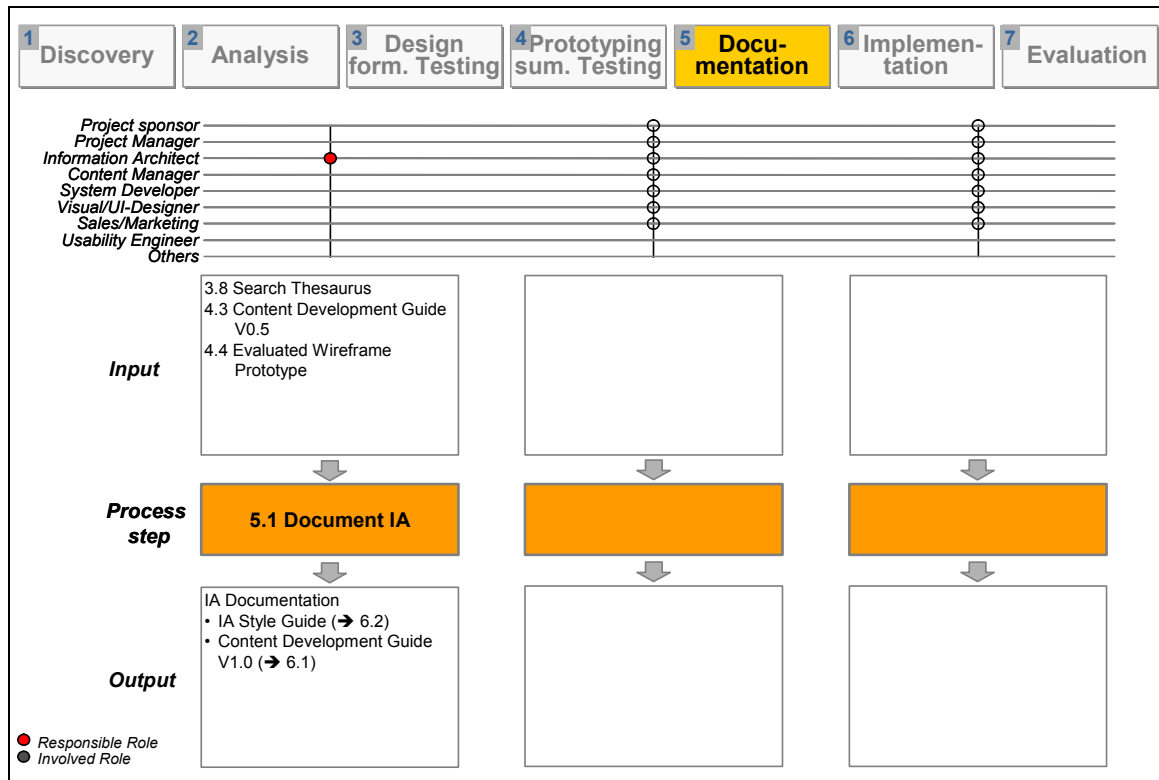
Appendix B-3.1: IA Process Model V0.5: Documentation of Process Phases

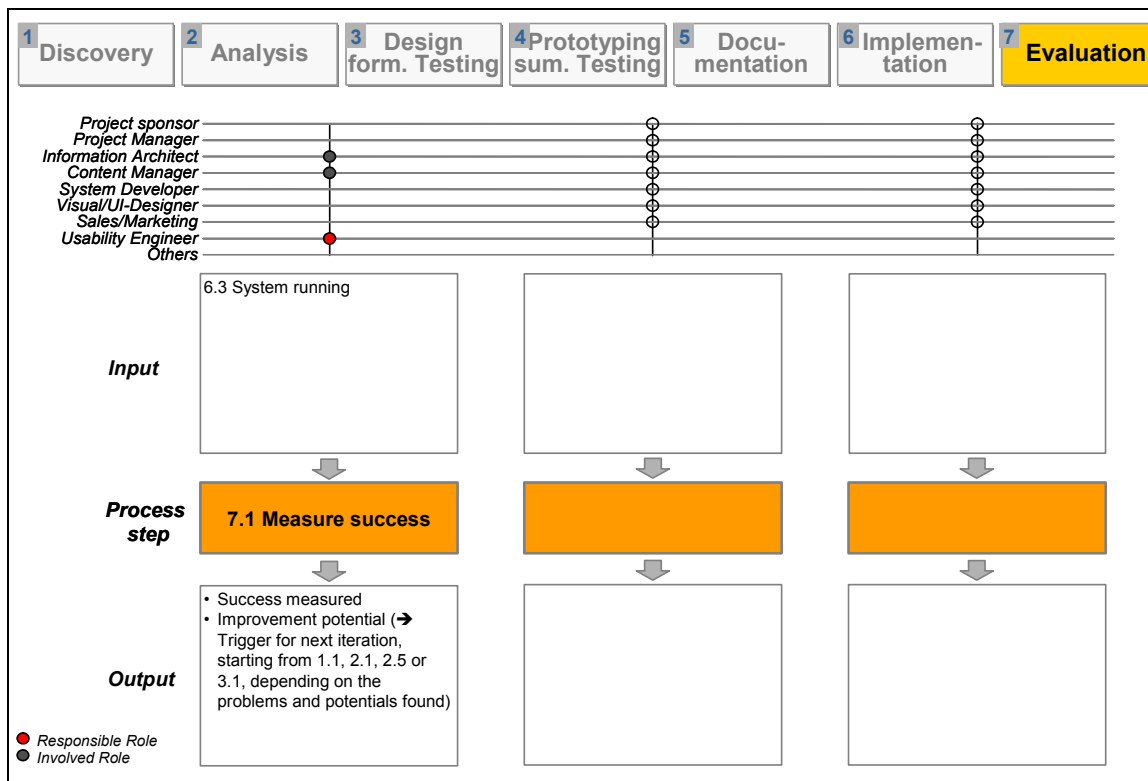












Appendix B-4: Step 6: Expert Evaluation Focus Group: IA Method Ratings

Method	SC1: IA Process Phase						SC2 - SC4			
Selection Criteria: SC1: Applicability in process phase # SC2: Resources needed (1-5) SC3: End user participation necessary (y/n) SC4: Necessary UCD experience (1-5)	1 Discovery	2 Analysis	3 Design & f. T.	4 Prototyping & s. T.	6 Implementation	7 Evaluation	SC2 (1-5)	SC3 (y/n)	SC4 (1-5)	# of ratings
Affinity Diagramming	x	x	x				1,5	y	1,5	4
Best Practice/ Competitive Analysis	x	x	x			x	3	n	3	8
Card Sorting		x	x			x	2	y	3	7
Consolidated Assessment		x	x				3,5	y	4	2
Content Inventory	x	x					3	y	4	3
Contextual Inquiry	x	x	x				4	y	5	7
Critical Incident Technique		x	x			x	2	y	3	6
Diary keeping	x	x					3	y	2	5
End User Feedback Analysis		x				x	3	y	3	7
Field study							5	y	4	8
Focus Group / Group Discussion							3	y	4	9/7
Free Listing	x	x				x	1	y	1,5	5
Functionality matrix	x	x	x	x		x	3	y	4	3
Interface Design Patterns		x					4	y	4,5	5
Interview		x			x		2	y	4	9
Log File Analysis	x	x	x	x		x	3	n	3	2

Parallel design		x	x	x	x		4,5	y	4,5	4
Participatory Design	x	x	x	x		x	4	y	4	6
Prioritization exercise							3	y	3	3
Prototyping							3	n	3	1
Paper Prototyping							2	y	3	8
Video Prototyping		x				x	3	n	2	3
Computer-based (Rapid) Pt			x				4	y	4	6
Wireframe Prototyping		x	x	x			3	n	3,5	6
Questionnaire		x					3	y	3,5	9
Scenarios, scenario building exercise			x	x			3	y	4	7
Storyboarding			x	x			2,5	y	3	6
Survey			x	x			3	y	3,5	6
Task Analysis			x	x	x	x	4	y	4	9
Task Allocation chart			x	x			4	n	4	3
Usability Context Analysis	x	x	x	x		x	3,5	y	4	6
(Usability) Inspection		x	x	x			2	y	4	7
Heuristic evaluation			x	x		x	2	n	4	7
Guideline reviews		x	x			x	2	n	4	4
Standards inspections		x	x				2	n	4	4
Formal Usability inspection		x					3,5	y	4,5	4
Consistency inspections		x					2	n	3	5
Human performance models		x	x	x		x	5	n	5	3
(Usability) Test		x	x	x		x	4	y	4	6
Performance measurement		x	x	x		x	4	y	3	7
Co-operative evaluation		x	x	x		x	4	y	4	5
Wizard of Oz technique		x	x	x		x	4	y	3	5
Perceived IA Test		x	x	x		x	3	y	4	3
Structure evaluation		x		x		x	3	y	3	4
Card-based classification evaluation		x	x	x		x	3	y	2	3
User Profile analysis/ Persona dev.		x		x		x	3	y	4	5
Walkthrough		x	x	x		x	2	y	4	4
Pluralistic Walkthrough			x	x		x	3	y	4	5
Cognitive Walkthrough			x			x	2	y	4	7
Usability Walkthrough			x				3	y	4	5
Workshop			x				3	y	4	5
Brainstorming	x	x					2,5	y	3	6
Stakeholder meeting		x	x	x		x	2	y	3	3

Appendix B-5: Step 7: Validation Project - Phase 1: Discovery

Appendix B-5.1: IA Business Brief – Table of Contents

In the following, the overall Table of Contents (translated from German) for the IA Business Brief is presented, which documented the information collected in the kick-off workshop and stakeholder interviews during the Discovery phase for the OSP Project.

Executive Summary	
1 Project Description	
2 Business Context SBS TS	
2.1 Business Data.....	
2.2 Basic Business Conditions	
2.3 Business Goals / - Requirements	
2.4 Competitors	
3 Characteristics of the Application SBS TS OSP	
3.1 Name / Version of the Application	
3.2 Specific Goals for the Application	
3.3 Application Actual State	
3.4 Application Target State	
3.5 Basic Scenarios of Use.....	
3.6 Basic Usage Data	
3.7 Basic Constraints for the Application	
3.7.1 Technical Constraints	
3.7.2 Constraints with regard to Visual Design	
3.7.3 Constraints with regard to Content Management	
3.7.4 Constraints with regard to Information Architecture	
4 Target Group End Users	
4.1 Description of Target Group End Users.....	
4.2 Available Documentation on Target Group End Users.....	
4.3 Recruiting and Involvement of End Users in the Design Process	
4.4 Participants for Analysis - End Users	
5 Target Group Content Providers	
5.1 Description of Target Group Content Providers.....	
5.2 Available Documentation on Target Group Content Providers.....	
5.3 Recruiting and Involvement of Content Providers in the Design Process	
5.4 Participants for Analysis - Content Providers	
6 Project Planning	
6.1 Project Focus.....	
6.2 Project Goals	
6.3 Project Success Criteria	
7 Project Team	
8 Design Process: Overview.....	
8.1 Start and End of the Project.....	
8.2 Overview: Work Packages.....	
8.3 Milestones.....	
8.4 Vacations, Absences	
8.5 Risk Management.....	
8.6 Additional internal Resources	
9 Detailed Design Process and Decision Process	
10 Annex: Overview IA Design Process	

Appendix B-6: Step 7: Validation Project - Phase 2: Analysis

Appendix B-6.1: Stakeholder interviews - Actual State OSP Data Model

Tabular Description of Database Tables (Example)

ABAPDictionary		Rel.46C		YJT2VTAART	
<hr/>					
YJT2VTAART					
Kurzbeschreibung SOKRATES:Textarten					
TransparenteTabelle					
AktiveVersion					
Feldstruktur					
Feldanzahl:8					
SummederFeldlängen:32					
Feldname	K	Typ	Länge	Datenelem.	Kurztext
<hr/>					
MANDT	X	CLNT	3	Y0T0MANDT	SOKRATES: SAP-Feld Mandant
TXTAID	X	CHAR	2	Y9T1TXTAID	SOKRATES: Textarten-Id
BEARB		CHAR	12	Y0T0XUBNME	SOKRATES: SAP-Feld Benutzer
ANDDAT		DATS	8	Y9T1ANDDAT	SOKRATES: Änderungs-Datum
STATUS		CHAR	1	Y9T1STATUS	SOKRATES: Status
SPALTEN		DEC	2	Y9T1COLUMN	SOKRATES: Anzahl Spalten
ZEILEN		DEC	3	Y9T1ROW	SOKRATES: Anzahl Zeilen
ATYP		CHAR	1	/SIE/SO_1T1TYP	Texttyp der Textart
<hr/>					
TechnischeEinstellungen					
Datenart: APPL0					
Größenkategorie:0					
Pufferungnichterlaubt					
Protokollierungausgeschaltet					
Eingabeprüfungen (Fremdschlüssel, Festwerte)					
MANDTwirdgeprüftgegenPrüftabelleT000					
Feldzuordnung:					
T000-MANDT=YJT2VTAART-MANDT					
STATUSgeprüftgegenFestwerteausDomäneY9T1RMSTS					
Festwerte:					
		freigegeben			
X		gesperrt			
ATYPgeprüftgegenFestwerteausDomäne/SIE/SO_1T1TYP					
Festwerte:					
AnzeigeStandardtext					
V		HyperlinkalsVerweisaufexternesKursprogramm			

Appendix B-6.2: Consolidated Assessment

Recruiting Script for End Users and Content Providers (in German)

Allgemeines

Die Website des Online-Seminarprogramms (OSP) der Siemens Business Services Training and Services soll überarbeitet werden. Dazu sollen schon im Vorhinein Anforderungen von den relevanten Zielgruppen gesammelt werden, um eine benutzerfreundlichere Anwendung zu erreichen.

Zielgruppen sind dabei zum einen die Endnutzer, also diejenigen, die Kurse über das OSP buchen; zum anderen aber auch die Content Produzenten, also diejenigen, die Kursbeschreibungen erstellen und in das OSP eingeben müssen.

Um die Anforderungen zu erheben, sollen Interviews mit Mitgliedern dieser Zielgruppen durchgeführt werden. Ziel dabei ist es, ein detailliertes Verständnis ihrer Anforderungen zu erarbeiten.

Die Interviews werden in der Zeit vom 13. bis 31.10 am Arbeitsplatz der Teilnehmer stattfinden und jeweils maximal 2h in Anspruch nehmen.

Die Teilnehmer erhalten für ihre Mitarbeit ein kleines Dankeschön.

Zielgruppe 1: Endnutzer

Die Zielgruppe Endnutzer wird aus 12 Teilnehmern bestehen, die jeweils mindestens einmal in den letzten 12 Monaten über das OSP oder eine Mitbewerber-Anwendung einen Weiterbildungskurs gebucht hat.

Primäre Auswahlkriterien

Primäre Auswahlkriterien sind Attribute der Zielgruppe (z.B. Alter, Geschlecht). Jedes Attribut kann mehrere Ausprägungen haben (z.B. männlich, weiblich)

#	Attribut	Ausprägungen
1	Siemens intern/extern	a) Siemens-interne vs. b) externe Kunden
2	Größe des Kundenunternehmens	a) Kleinunternehmen (bzw. Privatpersonen) vs. b) Großunternehmen
3	Job-Rolle	a) Entscheider (bzw. Meldestelle) vs. b) Kursteilnehmer (bzw. Selbstbucher)

Endnutzer-Segmente

Aus der Kombination der verschiedenen Ausprägungen der primären Auswahlkriterien (z.B. Jugendliche / männlich) ergeben sich folgende Endnutzer-Segmente; für jedes dieser Segmente sollen jeweils 3 Teilnehmer akquiriert werden, insgesamt also 12.

Sg#	Endnutzersegment: Bezeichnung	Akquiriert von
1	Siemens-intern / - / Entscheider (bzw. Meldestelle)	AE
2	Siemens-intern / - / Kursteilnehmer (bzw. Selbstbucher)	AE
3	Siemens-extern / Kleinunternehmen / -	AE
4	Siemens-extern / Großunternehmen / -	AE

Sekundäre Auswahlkriterien

Sekundäre Kriterien werden bei der Auswahl der Teilnehmer ebenso berücksichtigt, jedoch wird das Kriterium nicht systematisch variiert; alle Teilnehmer sollen das Kriterium in der gleichen Weise erfüllen.

Weiterbildungsprofil:

- Die Teilnehmer sollten mindestens einmal in den letzten 12 Monaten einen Weiterbildungskurs online gebucht haben, entweder mit Hilfe des OSP oder einer der Mitbewerber-Anwendungen.

Demographisches Profil:

- Geschlecht: Hauptsächlich männliche Teilnehmer, insgesamt nicht mehr als 2 Frauen
- Alter: 25-45 Jahre, insgesamt nur 1 Teilnehmer/in unter 25 / über 45

Logistisches:

- Können in der Zeit vom 13. bis 31.10 maximal 2h Zeit aufwenden für das Interview
- Die Interviews finden am jeweiligen Arbeitsplatz statt; daher sollten die Teilnehmer aus München oder der näheren Umgebung kommen (weitere Entfernung ist aber kein Ausschlusskriterium)

Zusätzliches:

- Nicht im Webdesign oder Weiterbildungssektor tätig
- Keine Teilnahme an Marketing- / Usability-Studien in den letzten 12 Monaten

Zielgruppe 2: Content Produzenten

Die Zielgruppe Content Produzenten wird aus 6 Teilnehmern bestehen, die für das OSP Kursbeschreibungen verfasst haben bzw. in der Erstellung von Kursbeschreibungen involviert sind.

Primäre Auswahlkriterien

Primäre Auswahlkriterien sind Attribute der Zielgruppe (z.B. Alter, Geschlecht). Jedes Attribut kann mehrere Ausprägungen haben (z.B. männlich, weiblich)

#	Attribut	Ausprägungen
1	Jobrolle	(a)Trainer vs. (b) Produkt Manager

Content-Produzenten Segmente

Aus der Kombination der verschiedenen Ausprägungen der primären Auswahlkriterien (z.B. Jugendliche / männlich) ergeben sich folgende Content-Produzenten Segmente; für jedes dieser Segmente sollen jeweils 3 Teilnehmer akquiriert werden, insgesamt also 6.

Sg#	Endnutzersegment: Bezeichnung	Akquiriert von
1	Trainer	AE
2	Produkt Manager	AE

Sekundäre Auswahlkriterien

Sekundäre Kriterien werden bei der Auswahl der Teilnehmer ebenso berücksichtigt, jedoch wird das Kriterium nicht systematisch variiert; alle Teilnehmer sollen das Kriterium in der gleichen Weise erfüllen.

OSP-Erfahrung:

- Die Teilnehmer sollten mindestens einmal in den letzten 12 Monaten eine Kursbeschreibung für das OSP erstellt oder in das OSP eingegeben haben

Logistisches:

- Können in der Zeit vom 13. bis 31.10 maximal 2h Zeit aufwenden für das Interview
- Die Interviews finden am jeweiligen Arbeitsplatz statt; daher sollten die Teilnehmer aus München oder der näheren Umgebung kommen (weitere Entfernung ist aber kein Ausschlusskriterium)

Zusätzliches:

- Nicht im Webdesign oder Weiterbildungssektor tätig
- Keine Teilnahme an Marketing- / Usability-Studien in den letzten 12 Monaten

Planung der Interview-Termine

- Zwischen den Terminen sollte minimal 1h Abstand gehalten werden.
- Je nach geographischer Entfernung muss dieser Abstand auch erhöht werden
- innerhalb Münchens durchschnittliche ÖPNV-Fahrtzeiten einkalkulieren: www.mvv-muenchen.de
- außerhalb Münchens durchschnittliche Pkw-Fahrtzeiten einkalkulieren, z.B. mit www.map24.de
- Maximal 3 Interviews pro Tag (Morgens, vor/nach Mittag, Nachmittags/Abends)

Leitfaden für die Akquisegespräche**Endnutzer:**

„Die Website des Online-Seminarprogramms (OSP) von Siemens / SBS TS, mit der man berufliche Weiterbildungskurse über das Internet buchen kann, soll überarbeitet werden. Dazu sollen schon im Vorhinein Anforderungen von den Nutzern der Website gesammelt werden, um eine benutzerfreundlichere Anwendung zu erreichen. Dazu jetzt ein paar Fragen:“

Fr#	Frage	Mögliche Antworten	Anweisung
1	Haben Sie schon einmal einen Weiterbildungskurs über das Internet gebucht? Wenn ja, wie lange ist das her?	Nein Ja, >12 Monate Ja, <12 Monate	ABBRUCH ABBRUCH WEITER mit Frage 2
2	Wie heißt Ihr Arbeitgeber/ Ihre Abteilung?	Siemens: Abteilung: Extern: Firmenname:	WEITER mit Frage 3 ABBRUCH nach 6 Teilnehmer WEITER mit Frage 4 ABBRUCH nach 6 Teilnehmer
3	Haben Sie den Weiterbildungskurs für sich selbst oder für einen Kollegen in Ihrer Abteilung gebucht?	Für mich selbst (=Selbstbucher) Für jemand anderes (=Entscheider bzw. Meldestelle)	WEITER mit Frage 5 ABBRUCH nach 3 Teilnehmer WEITER mit Frage 5 ABBRUCH nach 3 Teilnehmer
4	Wie groß ist Ihr Unternehmen, gemessen an der Zahl der Mitarbeiter? (Nach EU-Definition)	<250 (Kleinst-, Klein- & Mittelständ. Unternehmen) >250 (Großunternehmen)	WEITER mit Frage 5 ABBRUCH nach 3 Teilnehmer WEITER mit Frage 5 ABBRUCH nach 3 Teilnehmer
5	Sind Sie selbst im Bereich Webdesign oder Weiterbildung tätig?	Ja Nein	ABBRUCH WEITER mit Frage 6
6	Wo befindet sich ihr Arbeitsplatz?	München-Stadt & Umland Bayern Außerhalb Bayerns	WEITER mit Frage 7 WEITER mit Frage 7 ABBRUCH nach 6 Teilnehmer ABBRUCH
7	Haben Sie in den letzten 12 Monaten an Marketing- oder Usability-Studien teilgenommen?	Ja Nein	ABBRUCH WEITER mit Frage 8
8	Verraten sie uns noch ihr Alter?	<25 25<x<45 >45	ABBRUCH nach 1 Teilnehmer WEITER mit TERMIN VEREINBAREN ABBRUCH nach 1 Teilnehmer
9			
11	ABBRUCH		

TERMIN VEREINBAREN:

„Ok, vielen Dank. Wären Sie bereit, für einen Kursgutschein (im Wert von x EUR) oder ein kleines Geschenk mit uns ein Interview durchzuführen, um Ihre Anforderungen an die verbesserte Website zu sammeln?“

Das Interview würde in der Zeit vom 13. bis 31.10 an ihrem Arbeitsplatz (oder einem Ort Ihrer Wahl) stattfinden und maximal 2h in Anspruch nehmen. Ihre Mitarbeit daran würde uns wirklich sehr viel weiter helfen.“

Content Produzenten:

„Die Website des Online-Seminarprogramms (OSP) von Siemens / SBS TS, mit der man berufliche Weiterbildungskurse über das Internet buchen kann, soll überarbeitet werden. Dazu sollen schon im Vorhinein Anforderungen auch von denjenigen gesammelt werden, die Inhalte für das OSP erstellen und in das System einfügen, um die Qualität dieser Inhalte zu maximieren und damit eine benutzerfreundlichere Anwendung zu erreichen. Dazu jetzt ein paar Fragen:“

Fr#	Frage	Mögliche Antworten	Anweisung
1	Haben Sie schon einmal eine Kursbeschreibung für das OSP erstellt oder diese in das System eingegeben? Wenn ja, wie lange ist das her?	Nein	ABBRUCH
		Ja, >12 Monate	ABBRUCH
		Ja, <12 Monate	WEITER mit Frage 2
2	In welcher Funktion haben Sie das gemacht? Als Trainer oder als Produkt-Manager?	Trainer	WEITER mit Frage 3 ABBRUCH nach 3 Teilnehmer
		Produkt-Manager (bzw. nicht selbst Trainer)	WEITER mit Frage 3 ABBRUCH nach 3 Teilnehmer
3	Wie heißt Ihr Arbeitgeber/ Ihre Abteilung?	_____	WEITER mit Frage 4
4	Wo befindet sich ihr Arbeitsplatz?	Bayern	WEITER mit Frage 5
		Außerhalb Bayerns	WEITER mit Frage 5 ABBRUCH falls organisatorisch nicht möglich
5	Sind Sie selbst auch im Bereich Webdesign tätig?	Ja	ABBRUCH
		Nein	WEITER mit Frage 6
6	Haben Sie in den letzten 12 Monaten an Marketing- oder Usability-Studien teilgenommen?	Ja	ABBRUCH
		Nein	WEITER mit TERMIN VEREINBAREN
	ABBRUCH		

TERMIN VEREINBAREN:

„Ok, vielen Dank. Wären Sie bereit, für einen Kursgutschein (im Wert von x EUR) oder ein kleines Geschenk mit uns ein Interview durchzuführen, um Ihre Anforderungen an die verbesserte Website zu sammeln?

Das Interview würde in der Zeit vom 13. bis 31.10 an ihrem Arbeitsplatz (oder einem Ort Ihrer Wahl) stattfinden und maximal 2h in Anspruch nehmen. Ihre Mitarbeit daran würde uns wirklich sehr viel weiter helfen.“

Pre-Session Questionnaire for End Users (in German)

Über diesen Fragebogen

Dieser Fragebogen soll uns dabei helfen, die Wünsche und Anforderungen der tatsächlichen Anwender des Online Seminarprogramms genauer zu verstehen, um die Anwendung besser und einfacher zu machen.

Alle Informationen werden streng vertraulich behandelt. Ihr Name wird nicht mit diesem Fragebogen gespeichert, und die gegebenen Informationen werden nur intern verwendet.

Persönliche & berufliche Daten

Verraten Sie uns einige Angaben zu Ihrer Person und ihrem Beruf?

#		
1	Alter	
2	Geschlecht	<input type="checkbox"/> weiblich <input type="checkbox"/> männlich
3	Schulbildung	<input type="checkbox"/> Hochschulabschluss <input type="checkbox"/> Abitur <input type="checkbox"/> Mittlere Reife <input type="checkbox"/> Hauptschulabschluss <input type="checkbox"/> kein Abschluss
4	Berufsausbildung	
5	Gegenwärtige Berufsbezeichnung	
6	Arbeitgeber: Bezeichnung, Standort	
7	Falls Siemens-extern, wie viele Mitarbeiter beschäftigt Ihr Arbeitgeber?	<input type="checkbox"/> <250 (Kleinst-, Klein- & Mittelständ. Unternehmen) <input type="checkbox"/> >250 (Großunternehmen)
8	Wie lange arbeiten Sie in Ihrer gegenwärtigen Position?	<input type="checkbox"/> Weniger als 6 Monate <input type="checkbox"/> 6 Monate – 1 Jahr <input type="checkbox"/> 1 – 2 Jahre <input type="checkbox"/> Über 2 Jahre <input type="checkbox"/> Sonstiges:
9	Wie lange arbeiten Sie bei Ihrem gegenwärtigen Arbeitgeber?	<input type="checkbox"/> Weniger als 6 Monate <input type="checkbox"/> 6 Monate – 1 Jahr <input type="checkbox"/> 1 – 2 Jahre <input type="checkbox"/> Über 2 Jahre <input type="checkbox"/> Sonstiges:
10	Tragen Sie Personalverantwortung? Wenn ja, für wie viele Mitarbeiter?	<input type="checkbox"/> Nein <input type="checkbox"/> Ja; # der Mitarbeiter:
11	Haben Sie schon einmal einen Kurs über das Internet bei Siemens SBS gebucht? Wenn ja, welchen?	<input type="checkbox"/> Nein <input type="checkbox"/> Ja; Bezeichnung/Inhalt:
12	Haben Sie den Weiterbildungskurs für sich selbst oder für einen Kollegen in Ihrer Abteilung gebucht?	<input type="checkbox"/> Für mich selbst <input type="checkbox"/> Für jemand anderes:
13	Was ist Ihre Muttersprache? Welche anderen Sprachen sprechen sie noch? Fließend?	

Computer-Erfahrung

Über welche Erfahrung im Umgang mit Computer verfügen Sie?

#		
1	Seit wann benutzen Sie Computer?	<input type="checkbox"/> Weniger als 6 Monate <input type="checkbox"/> 6 bis 12 Monate <input type="checkbox"/> 1 – 2 Jahre <input type="checkbox"/> 2 bis 5 Jahre <input type="checkbox"/> Mehr als 5 Jahre
2	Wie häufig benutzen Sie Computer?	<input type="checkbox"/> Maximal einmal im Monat <input type="checkbox"/> 1 bis 2 Mal pro Woche <input type="checkbox"/> Mehrmals pro Woche <input type="checkbox"/> Jeden Tag
3	Wie würden Sie Ihren Kompetenz-Grad im Hinblick auf Computer-Erfahrung selbst einschätzen?	<input type="checkbox"/> Anfänger <input type="checkbox"/> Fortgeschrittener <input type="checkbox"/> Experte
4	Welche Anwendungsprogramme benutzen sie?	<input type="checkbox"/> Microsoft Word <input type="checkbox"/> Excel <input type="checkbox"/> PowerPoint <input type="checkbox"/> Access <input type="checkbox"/> Outlook <input type="checkbox"/> Sonstige:

Internet-Erfahrung

Über welche Erfahrung mit dem Internet verfügen Sie?

#		
1	Seit wann benutzen Sie das Internet?	<input type="checkbox"/> Weniger als 6 Monate <input type="checkbox"/> 6 bis 12 Monate <input type="checkbox"/> 1 – 2 Jahre <input type="checkbox"/> 2 bis 5 Jahre <input type="checkbox"/> Mehr als 5 Jahre
2	Wie häufig benutzen Sie das Internet?	<input type="checkbox"/> Maximal einmal im Monat <input type="checkbox"/> 1 bis 2 Mal pro Woche <input type="checkbox"/> Mehrmals pro Woche <input type="checkbox"/> Jeden Tag
3	Wie würden Sie Ihren Kompetenz-Grad im Hinblick auf Internet-Erfahrung selbst einschätzen?	<input type="checkbox"/> Anfänger <input type="checkbox"/> Fortgeschrittener <input type="checkbox"/> Experte

Benutzte Hard- und Software

Über welchen Computer verfügen Sie am Arbeitsplatz und welche Software ist auf ihm installiert?

#		
1	Computer	<input type="checkbox"/> Desktop PC <input type="checkbox"/> Laptop
2	Betriebssystem	Firma: Produkt: Version #: Sprache:
3	WWW Browser	Firma: Produkt: Version #: Sprache:
4	Graphische Auflösung	<input type="checkbox"/> 640 x 480 <input type="checkbox"/> 800 x 600 <input type="checkbox"/> 1024 x 768 <input type="checkbox"/> 1052 x 864 <input type="checkbox"/> 1280 x 1024 <input type="checkbox"/> 1600 x 1200 <input type="checkbox"/> Weiß ich nicht / Sonstiges:
5	Übertragungsrate	<input type="checkbox"/> Modem <input type="checkbox"/> ISDN <input type="checkbox"/> DSL (T1) <input type="checkbox"/> LAN <input type="checkbox"/> Weiß ich nicht / Sonstiges:

Arbeitsplatz, Umfeld

Wie lässt sich ihr Arbeitsplatz charakterisieren? In welchem Umfeld arbeiten Sie?

#		
1	Größe ihres Büros (ca. m ²)	
2	# von Kollegen im Raum	

*Pre-Session Questionnaire for Content Providers (in German)***Über diesen Fragebogen**

Dieser Fragebogen soll uns dabei helfen, die Wünsche und Anforderungen der Mitarbeiter, die Inhalte für das Online Seminarprogramm erstellen, genauer zu verstehen. Ziel dabei ist es, die Anwendung insgesamt besser und einfacher zu machen.

Alle Informationen werden streng vertraulich behandelt. Ihr Name wird nicht mit diesem Fragebogen gespeichert, und die gegebenen Informationen werden nur intern verwendet.

Persönliche & berufliche Daten

Verraten Sie uns einige Angaben zu Ihrer Person und ihrem Beruf?

#		
1	Alter	
2	Geschlecht	<input type="checkbox"/> weiblich <input type="checkbox"/> männlich
3	Schulbildung	<input type="checkbox"/> Hochschulabschluss <input type="checkbox"/> Abitur <input type="checkbox"/> Mittlere Reife <input type="checkbox"/> Hauptschulabschluss <input type="checkbox"/> kein Abschluss
4	Berufsausbildung	
5	Gegenwärtige Berufsbezeichnung	
6	Arbeitgeber: Bezeichnung, Standort	
7	Wie lange arbeiten Sie in Ihrer gegenwärtigen Position?	<input type="checkbox"/> Weniger als 6 Monate <input type="checkbox"/> 6 Monate – 1 Jahr <input type="checkbox"/> 1 – 2 Jahre <input type="checkbox"/> Über 2 Jahre <input type="checkbox"/> Sonstiges:
8	Wie lange arbeiten Sie bei Ihrem gegenwärtigen Arbeitgeber?	<input type="checkbox"/> Weniger als 6 Monate <input type="checkbox"/> 6 Monate – 1 Jahr <input type="checkbox"/> 1 – 2 Jahre <input type="checkbox"/> Über 2 Jahre <input type="checkbox"/> Sonstiges:
9	Tragen Sie Personalverantwortung? Wenn ja, für wie viele Mitarbeiter?	<input type="checkbox"/> Nein <input type="checkbox"/> Ja; # der Mitarbeiter:
10	In welcher Funktion haben Sie die Kursbeschreibung für das OSP erstellt?	<input type="checkbox"/> Trainer <input type="checkbox"/> Produkt-Manager <input type="checkbox"/> Sonstiges:
11	Was ist Ihre Muttersprache? Welche anderen Sprachen sprechen sie noch? Fließend?	

Computer-Erfahrung

Über welche Erfahrung im Umgang mit Computer verfügen Sie?

#		
1	Seit wann benutzen Sie Computer?	<input type="checkbox"/> Weniger als 6 Monate <input type="checkbox"/> 6 bis 12 Monate <input type="checkbox"/> 1 – 2 Jahre <input type="checkbox"/> 2 bis 5 Jahre <input type="checkbox"/> Mehr als 5 Jahre
2	Wie häufig benutzen Sie Computer?	<input type="checkbox"/> Maximal einmal im Monat <input type="checkbox"/> 1 bis 2 Mal pro Woche <input type="checkbox"/> Mehrmals pro Woche <input type="checkbox"/> Jeden Tag
3	Wie würden Sie Ihren Kompetenz-Grad im Hinblick auf Computer-Erfahrung selbst einschätzen?	<input type="checkbox"/> Anfänger <input type="checkbox"/> Fortgeschrittener <input type="checkbox"/> Experte
4	Welche Anwendungsprogramme benutzen sie?	<input type="checkbox"/> Microsoft Word <input type="checkbox"/> Excel <input type="checkbox"/> PowerPoint <input type="checkbox"/> Access <input type="checkbox"/> Outlook <input type="checkbox"/> Sonstige:

Internet-Erfahrung

Über welche Erfahrung mit dem Internet verfügen Sie?

#		
1	Seit wann benutzen Sie das Internet?	<input type="checkbox"/> Weniger als 6 Monate <input type="checkbox"/> 6 bis 12 Monate <input type="checkbox"/> 1 – 2 Jahre <input type="checkbox"/> 2 bis 5 Jahre <input type="checkbox"/> Mehr als 5 Jahre
2	Wie häufig benutzen Sie das Internet?	<input type="checkbox"/> Maximal einmal im Monat <input type="checkbox"/> 1 bis 2 Mal pro Woche <input type="checkbox"/> Mehrmals pro Woche <input type="checkbox"/> Jeden Tag
3	Wie würden Sie Ihren Kompetenz-Grad im Hinblick auf Internet-Erfahrung selbst einschätzen?	<input type="checkbox"/> Anfänger <input type="checkbox"/> Fortgeschrittener <input type="checkbox"/> Experte

End User Rating: Relevancy of Basic Usage Scenarios

ID	Basic Usage Scenario Description	Median ¹⁸⁴
S1a (b)	Finding a seminar on a given topic using the navigation (search functionality), and making a reservation online	1
S2a (b)	Finding seminars at a given training site / date using the navigation (search functionality), and making a reservation online	5
S3a (b)	Finding seminars conducted with a particular teaching method (e-learning vs. classroom seminars) using the navigation (search functionality), and making a reservation online	4
S4a (b)	Finding seminars conducted by a particular trainer using the navigation (search functionality), and making a reservation online	9
S5	Checking the status of a particular seminar (further reservations possible, hotel rooms available)	5
S6	Cancel an existing seminar reservation	6
S7a (b)	finding seminars which follow a seminar in a given sequence using the navigation (search functionality), and making a reservation online	5
S8	Search for keywords using the search functionality	1
S9	Checking the personal booking history	7

Material: Existing Content (C; Translated from German)

ID	Content item	Description
C1	Short title	Short title for a seminar
C2	Product group/TTG	Product group a seminar relates to
C3	Responsible/CM	Responsible product manager
C4	Duration	Duration of the seminar
C5	Visible in OSP from:	Start date for the seminar to be visible in OSP
C6	Language	Languages provided for the seminar description
C7	Long title	Long title for the seminar
C8	List price/fixed price/price valid from:	Prices for the seminar and respective valid dates
C9	Room type	Characteristics of the room where the seminar takes place
C10	Seminar description: contents	Contents of the seminar

¹⁸⁴ Median computed for rankings of scenarios with regard to how relevant and reflective they are across all end users; 1 = first rank, 9 = last rank

C11	Seminar description: goals	Goals of the seminar
C12	Seminar description: benefits	Benefits of the seminar
C13	Seminar description: target group	Target group of the seminar
C14	Further training route diagram	Diagram showing a logical sequence of seminars
C15	Certification text	Text for a certificate given to participants after the seminar
C16	Display internal/external OSP	Visible in the OSP from outside, inside Siemens, or both
C17	Additional portals	Other SBS T&S portals where seminar is to be included
C18	Product seminar /IT seminar	Type of seminar: product-related or technology-related
C19	Chapter/sub-chapter/topic	Location of seminar within seminar catalog
C20	Dates: date, time, venue	Dates for the seminar
C21	Additional agreements	Further agreements between participant and SBS T&S
C22	Materials to be provided	Materials necessary for the seminar
C23	Training site description: address, contact data, image	Generic information
C24	Training site description: maps	Maps of the area
C25	Training site description: how to get there by car	Driving directions
C26	Training site description: parking facilities	Information on where to park the car
C27	Terms and conditions :	General terms and conditions
C28	FAQs	frequently asked questions
C29	General information	“About us” information

Material: Existing Functionality (F; Translated from German)

ID	Functionality	Description
F1	Navigation by topic	Navigation in topical seminar catalog
F2	Search engine: keywords	Fielded seminar search for (topical) keywords
F3	Search engine: training sites	Fielded seminar search for training sites
F4	Search engine: date	Fielded seminar search for seminar dates
F5	Booking status	Check availability of seminar reservations
F6	Online booking	Book seminar online (including shopping cart, booking, my account)
F7	Print version	Print versions of seminar and training site descriptions
F8	Paper seminar catalogs	Order a paper seminar catalog
F9	Emails-newsletter	Order emails-newsletter
F10	Hotel reservation	Order hotel reservation for the seminar

Material: New Content (NC; Translated from German)

ID	New content item	Description
NC1	Linked pre-seminars	For each seminar, provide direct links to prerequisite seminars
NC2	Linked post-seminars	For each seminar, provide direct links to consecutive seminars
NC3	Additional site information: local traffic	Provide additional information about a given training site's local traffic
NC4	Additional site information: hotels	Provide additional information about a given training site's hotel room availability
NC5	Additional site information: city event calendar	Provide additional information about a given training site's city event calendar
NC6	Glossary	Provide a list of explanations of technical terms
NC7	Complete offerings	Offer a set of related seminars as one package
NC8	Optimized keyword tagging	Set up controlled vocabulary and develop workflow for optimum keyword tagging of seminars
NC9	Integrating attribute “teaching method”	Integrate attribute "teaching method" in navigation (e.g., e-learning vs. classroom seminars)
NC10	Split of seminar type and seminar	Split a seminar previously stored in the database as one into one for each training method (seminar type)

NC11	Last-minute seminar offerings	Provide special last-minute offers for seminars
------	-------------------------------	---

Material: New Functionality (NF; Translated from German)

ID	Functionality	Description
NF1	Navigation by training site	Navigation in seminars organized by training sites
NF2	Navigation by seminar date	Navigation in seminars organized by seminar dates
NF3	Navigation by teaching method	Navigation in seminars organized by teaching methods
NF4	Search engine: teaching method	Fielded seminar search for teaching methods
NF5	Credit card payment	Pay by credit card
NF6	PDF	Print PDF files of seminar descriptions
NF7	Send as Email	Send seminar descriptions by email
NF8	Customizable program	Compose a personal seminar program
NF9	Test for necessary skills	Online test for participants to check for skills necessary for a given seminar
NF10	Bookmarks	Bookmarkable pages throughout
NF11	Personal profile	Profile to be used for personal information via newsletter
NF12	„Real“ login	Full login functionality
NF13	Booking history	Complete personal booking history
NF14	Waiting list	Waiting list for fully booked seminars

Material: Screen Templates

Siemens AG - Training and Services - Microsoft Internet Explorer von Siemens				Notes:
Participant#:	Screen#:	Heading:	Scenario#:	
Adresse www.siemens.de/online-seminarprogramm				
<div> <div> </div> <div> Global Home Hilfe Kontakt </div> </div> <div> Siemens Business Services Deutschland </div>				
<div> <div>Start</div> <div>Inbox - Mi...</div> <div>FreeMail...</div> <div>Siemen...</div> <div>Microsoft ...</div> <div>Microsoft ...</div> <div>Explorer - ...</div> <div>Z:\User\S...</div> <div>Local intranet</div> <div>19:47</div> </div>				

End User Rating: Relevancy of Existing Content

ID	Content description (card labels, in German)	Median ¹⁸⁵
C1	Beschreibung des Kurses: Eindeutiges Kürzel (z.B. „Excel-Prof“)	4
C4	Beschreibung des Kurses: Dauer	5
C8	Beschreibung des Kurses: Preis zzgl./inkl. MwSt.	5
C10	Beschreibung des Kurses: Kursinhalte (welche Themen werden behandelt)	5
C11	Beschreibung des Kurses: Zielsetzung	5
C12	Beschreibung des Kurses: Nutzen/Mehrwert	4
C13	Beschreibung des Kurses: Zielgruppe	5
C14	Darstellung von Weiterbildungswegen: sinnvolle Reihenfolge von Kursen	4
C20	Beschreibung des Kurses: Termine: Datum, Zeit, Veranstaltungsort	5
C23	Beschreibung des Veranstaltungsortes: Adresse, Kontaktdaten, Foto	3
C24	Beschreibung des Veranstaltungsortes: Kartenausschnitt, Lageplan	5
C25	Beschreibung des Veranstaltungsortes: Beschreibung der Anfahrt mit Auto	5
C26	Beschreibung des Veranstaltungsortes: Parkmöglichkeiten	4
C27	AGBs: Allgemeine Geschäftsbedingungen	4
C28	FAQs: Häufig gestellte Fragen	3
C29	Allgemeines: Wir über uns	3

End User Rating: Relevancy of Existing Functionality

ID	Functionality description (card labels, in German)	Median ¹⁸⁶
F1	Navigation in Kursen nach Thema (thematisch geordneter Katalog von Kursen)	5
F2	Suchmaschine: Suche von Kursen über (thematische) Stichwörtern	5
F3	Suchmaschine: Suche von Kursen nach Veranstaltungsorten	4
F4	Suchmaschine: Suche von Kursen nach Zeitraum	4
F5	Kursverfügbarkeit einsehen (wie viele Plätze sind noch frei)	5
F6	Online-Buchung (Warenkorb, Buchung, MeinKonto)	5
F7	Druckversion von Kurs-, Veranstaltungsortbeschreibungen	5
F8	Bestellung von (Papier-) Kurskatalogen	3
F9	Bestellung von Email-Newsletter	3
F10	Hotelreservierung	3

End User Rating: Relevancy of New Content

ID	Content description (card labels, in German)	Median ¹⁸⁷
NC1	Beschreibung des Kurses: Voraussetzungen, notwendige Vorkurse (verlinkt)	5
NC2	Beschreibung des Kurses: Mögliche Nachfolgekurse (verlinkt)	4
NC3	Beschreibung des Veranstaltungsortes: Beschreibung der Anfahrt mit ÖPNV, Links zu ÖPNV-Unternehmen	5
NC4	Beschreibung des Kurses: Information über die Verfügbarkeit von Hotelzimmern (noch vor Buchung)	3
NC5	Beschreibung des Veranstaltungsortes: Zusätzliche Informationen: Stadtinfos, Hotels, Veranstaltungen etc.	3
NC6	Glossar: Erklärung von Fachwörtern (auch: Tooltips für einzelne Fachwörter)	3
NC7	Komplettangebote: Zusammenstellung mehrerer Kurse, Darstellung des Gesamtpreises &	4

¹⁸⁵ Median computed for ratings of importance of content elements across all end users; 1 = unimportant, 5 = important content element

¹⁸⁶ Median computed for ratings of importance of functionalities across all end users; 1 = unimportant, 5 = important functionality

¹⁸⁷ Median computed for ratings of importance of content elements across all end users; 1 = unimportant, 5 = important content element

	der gesamten Ausfalltage für den Teilnehmer	
NC10	Auftrennung von Kursform und Kurs	5 ¹⁸⁸
NC11	“Last-minute”-Angebote	3 ¹⁸⁸

End User Rating: Relevancy of New Functionality

ID	Functionality description (card labels, in German)	Median ¹⁸⁹
NF1	Navigation in Kursen nach Veranstaltungsort (nach Veranstaltungsorten geordneter Katalog von Kursen)	4
NF2	Navigation in Kursen nach Zeitraum (zeitlich geordneter Katalog von Kursen)	4
NF3	Navigation in Kursen nach Lehrmethode (methodisch geordneter Katalog von Kursen, z.B. E-Learning vs. Classroom)	4
NF4	Suchmaschine: Suche von Kursen nach Lehrmethode (z.B. E-Learning vs. Classroom)	4
NF5	Kursbuchungen mit Kreditkarten bezahlen	2
NF6	PDF-Version von Kurs-, Veranstaltungsortbeschreibungen, Buchungen	4
NF7	Als-Email versenden von Kurs-, Veranstaltungsortbeschreibungen	4
NF8	Personalisiertes Programm zusammenstellen und ausdrucken	3
NF9	Test, welche Kurse für meine Situation sinnvoll sind (z.B. Einsteiger- oder Fortgeschrittenenkurs?)	4
NF10	Bookmarks auf eine einzelne Seite setzen	3
NF11	Persönliches Profil hinterlegen, um personalisierte Informationen per Email zu bekommen (z.B. interessante Nachfolgekurse für mich)	3
NF12	Echter Login	4 ¹⁹⁰
NF13	Buchungshistorie	4 ¹⁹⁰
NF14	Warteliste	3 ¹⁹⁰

Content Provider Rating: Level of Effort for Existing Content

ID	Content description (card labels, in German)	Median ¹⁹¹
C1	Kurzbezeichnung	1
C2	Prod.grp/TTG	1
C3	Verantwortl./CM	1
C4	Dauer	3
C5	Sichtbar im OSP ab	1
C6	Sprache	1
C7	Langtitel	3
C8	Listenpreis/Festpreis/Preis gültig ab	4
C9	Raumtyp	2
C10	Seminarbeschreibung: Kursinhalte	4
C11	Seminarbeschreibung: Zielsetzung	4
C12	Seminarbeschreibung: Nutzen/Mehrwert	4
C13	Seminarbeschreibung: Zielgruppe	2
C14	Weiterbildungsgrafik	4
C15	Zertifikatstext	2
C16	Anzeige internes/externes OSP	2
C17	Weitere Portale	2
C18	Produktkurs/IT-Kurs	1,5

¹⁸⁸ Median value was inferred from end user requirements as identified during Consolidated Assessment

¹⁸⁹ Median computed for ratings of importance of functionalities across all end users; 1 = unimportant, 5 = important functionality

¹⁹⁰ Median value was inferred from end user requirements as identified during Consolidated Assessment

¹⁹¹ Median computed for ratings of effort involved in providing the respective content across all content providers; 1 = low effort, 5 = high effort involved

C19	Kapitel/Unterkapitel/Thema	3
C20	Termine: Datum, Zeit, Veranstaltungsort	3,5
C21	Besondere Vereinbarungen	3
C22	Bereitzustellende Unterlagen	3,5

Content Provider Rating: Overall Satisfaction with OSP (Selected Items)

ID	Description Of OSP Aspect (in German)	Median ¹⁹²
1.1	Content structure: adequate criterion	4
1.2	Content structure: adequate granularity of category range	4
1.3	Content structure: adequate depth of the hierarchy	4
1.4	Content structure: no missing categories	4
1.5	Content structure: possible to propose missing categories	4
1.6	Content structure: multi-selection of values possible	5
1.7	Content structure: stable categorization	4
1.8	Content structure: adequate location regarding own requirements	4
2.1	Layout: adequate screen space for single page elements	3
2.2	Layout: no missing / unwanted page elements	3
3.1	Labels: Labels for navigation	4
3.2	Labels: Labels for headings	3
4.1	Functionality: no missing / unwanted functionality	3
5.1	Content media type: appropriate media type	4
6.1	Content wording: adequate freedom of decision	5
7.1	Contextual navigation systems: possible to contextually link content	2
8.1	Indexes: possible to adequately incorporate content in an index	4
9.1	General: template for submitting seminar description	4
9.2	General: Would you work with the CMS on your own? (y=5/n=1)	2

Content Provider Rating: Level of Effort for New Content and Functionality

ID	Content description (card labels, in German)	Median ¹⁹³
NC1	Verlinkte Vorkurse	1
NC2	Verlinkte Nachkurse	1
NC3	Beschreibung des Veranstaltungsortes: Beschreibung der Anfahrt mit ÖPNV, Links zu ÖPNV-Unternehmen	1
NC4	Beschreibung des Kurses: Information über die Verfügbarkeit von Hotelzimmern (noch vor Buchung)	- ¹⁹⁴
NC5	Beschreibung des Veranstaltungsortes: Zusätzliche Informationen: Stadtinfos, Hotels, Veranstaltungen etc.	2
NC6	Glossar: Erklärung von Fachwörtern (auch: Tooltips für einzelne Fachwörter)	4
NC7	Komplettangebote: Zusammenstellung mehrerer Kurse, Darstellung des Gesamtpreises & der gesamten Ausfalltage für den Teilnehmer	5
NC8	Optimierte Keywords-Vergabe	4
NC9	Integrieren des Attributs "Lehrmethode"	2
NC10	Trennung von Kursform und Kurs	2,5
NC11	"Last-minute"-Angebote	3,5

¹⁹² Median across all content provider scores (1 = low satisfaction, 5 = high satisfaction). Content providers were interviewed in a semi-structure manner on their overall satisfaction with aspects of the OSP. Answers were rated both by the interviewer and note-taker on the five-step scale, and subsequently, the individual score was derived from the median value of both ratings.

¹⁹³ Median computed for ratings of effort involved in providing the additional content and functionality across all content providers; 1 = low effort, 5 = high effort involved

¹⁹⁴ No ratings available as this content is not delivered by the content providers interviewed

NF5	Kreditkartenzahlung der Buchung	1 ¹⁹⁵
NF6	PDF von Kursbeschreibungen	1 ¹⁹⁵
NF7	Als-Email Versenden von Kursbeschreibungen	1 ¹⁹⁵
NF8	Personalisierbares Programm	1 ¹⁹⁵
NF9	Eingangstest für Kurs	5
NF12	“Echter” Login	1 ¹⁹⁵
NF13	Komplette Buchungshistorie	1 ¹⁹⁵
NF14	Warteliste	3 ¹⁹⁶

Appendix B-6.3: IA Analysis Report

Table of Contents (Translated From German)

Executive Summary

1. Introduction

2. Results of the IA Analysis Phase

2.1 Available Material	
2.2 Competitive Analysis	
2.3 OSP-Analysis	
2.4 Results of Interviews with end users and content providers.....	

3. Prioritization of key requirements

4. Open issues

5. Next steps

Ratings of Overall Feasibility and Relevancy for Potential New Content and Functionality Elements

ID	Potential new content / functionality	Overall Rating		Feasibility		Relevancy	
		Overall feasibility	Overall relevancy	Technical feasibility	Feasibility for content providers ¹⁹⁷	For business goal achievement	For end users
NC1	Linked pre-seminars	4,5	4,25	4	5	3,5	5
NC2	Linked post-seminars	4,5	4	4	5	4	4
NC6	Glossary	3	2,5	4	2	2	3
NC7	Complete offerings	1,5	4	2	1	4	4
NC10	Split of seminar type and seminar	4	4,25	4	4	3,5	5

¹⁹⁵ Values set to 1 (low effort), as these functionalities do not require additional effort by any content provider

¹⁹⁶ Median value was inferred from content provider requirements as identified during Consolidated Assessment

¹⁹⁷ Values for content provider feasibility were derived by inverting level of effort ratings for new content and functionality elements (see 0): high (5) effort involved = low (1) feasibility, and vice versa.

NC11	Last-minute seminar offerings	2,75	3	3	2,5	3	3
NF5	Credit card payment	3,5	1,5	2	5	1	2
NF6	PDF	4	4,5	3	5	5	4
NF7	Send as Email	4	4	3	5	4	4
NF8	Customizable program	4	3	3	5	3	3
NF9	Test for necessary skills	2,5	3,5	4	1	3	4
NF12	„Real“ login	3,5	3,75	2	5	3,5	4
NF13	Booking history	3,5	4,25	2	5	4,5	4
NF14	Waiting list	3	3	3	3	3	3

Appendix B-6.4: Detailed Process Flow During Analysis

For each of the methods applied in the Analysis phase, input was drawn from various sources:

*For the **Content Inventory**:*

- IA Business Brief (basic description of the actual state of content of the OSP; CD-ROM with additional version of the OSP).

*For the **Usability Inspection**:*

- IA Business Brief (list of basic usage scenarios, preliminary prioritized; list of requirements derived from the previously conducted focus group by CT IC 7 to be inspected)
- Competitive Review (list of additional content and functionality elements to be inspected if available)
- Feedback Analysis (list of additional issues raised by OSP customers to be inspected)
- Consolidated Assessment (list of additional issues raised by participants to be inspected)

*For the **Feedback Analysis**:*

- IA Business Brief (list of available material with respective contact persons)

*For the **Competitive Review** from:*

- IA Business Brief (list of basic usage scenarios, preliminary prioritized; list of prioritized competitors; list of requirements derived from the previously conducted focus group by CT IC 7 to be further inspected)
- Feedback Analysis (list of additional issues raised by OSP customers to be inspected)
- Consolidated Assessment (list of additional issues raised by participants to be inspected)

For the Stakeholder Interviews:

- IA Business Brief (basic description of the actual state of the OSP database, list of respective contact persons)

For the Consolidated Assessment sessions with end users and content providers:

- IA Business Brief (list of basic usage scenarios, preliminary prioritized; list of end user and content provider user roles to be analyzed; list of requirements derived from the previously conducted focus group by CT IC 7 to be further analyzed)
- Competitive Review (list of additional functionalities to be analyzed with EU and CP)
- Usability Inspection (list of usability problems for further analysis and validation with EU)
- Feedback Analysis (list of additional issues raised by OSP customers to be analyzed)
- End user and content provider Consolidated Assessment sessions provided mutual input for each other (list of additional content / functionalities required by end users, to be rated by content providers with regard to the level of effort necessary; list of requirements mentioned by content providers, to be checked for end user approval)

Appendix B-7: Step 7: Validation Project - Phase 3: Design

Appendix B-7.1: Detailed Process Flow During Design

For each of the methods applied in the Design phase, input was drawn from various sources:

For prioritization, project phasing and strategy development:

- IA Analysis Report (list of prioritized OSP features according to overall feasibility and relevance; overall project planning data)

For the Content Requirements Collection, requirements were derived from:

- Prioritization, project phasing and strategy development (focus and scope of collecting content requirements)
- IA Analysis Report (mostly from end user and content provider Consolidated Assessment sessions, from competitive review, from usability inspection;)
- ERD Data Modeling (formal content requirements, metadata schemes, controlled vocabularies from existing data model)
- Blueprints (mostly from content structure and interaction flows)
- Wireframes (mostly from each screen's content, layout, navigation/search, and functionality)

- Visual Design (mostly from each screen's layout, icons, and images)

*For **ERD Data Modeling**:*

- Prioritization, project phasing and strategy development (focus and scope of data modeling activities)
- Content Requirements Collection (content requirements required existing database counterpart)
- Blueprints (content structure and interaction flows required existing database counterpart)
- Wireframes (content, layout, navigation/search, and functionality specifications for each screen required existing database counterpart)

*For **Blueprints**:*

- IA Analysis Report (OSP content structure from the previous focus group results; generic interaction flow diagram)
- Prioritization, project phasing and strategy development (focus and scope of blueprinting activities)
- Content Requirements Collection (mostly content requirements regarding structure of content)
- ERD Data Modeling (constraints from existing data model)
- Wireframes (amount of content for each screen affected amount of screens necessary for any given content and interaction flows; functionalities of individual screens required additional screens;)
- Visual Design (layout constraints requiring changes to content structure and interaction flows)

*For **Wireframes**:*

- IA Analysis Report (list of constraints from corporate online style guide;)
- Prioritization, project phasing and strategy development (focus and scope of wireframe design activities)
- Content Requirements Collection (mostly content requirements regarding granularity of content affected layout of individual screens)
- ERD Data Modeling (constraints from existing data model)
- Blueprints (content structure and interaction flows affected content, navigation, functionality available on individual screens)
- Visual Design (layout constraints from icons and images)

For Visual Design from:

- IA Analysis Report (list of constraints from corporate online style guide;)
- Content Requirements Collection (mostly content requirements regarding granularity of content affected visual layout of individual screens)
- Prioritization, project phasing and strategy development (focus and scope of visual design activities)
- ERD Data Modeling (constraints from existing data model)
- Blueprints (detailed interaction flow required and affected design of icons)
- Wireframes (navigation/search and functionalities of individual screens required and affected design of icons; layout constraints for icons and images)

Appendix B-8: Step 7: Validation Project - Phase 4: Prototyping & Testing

Appendix B-8.1: Content Development Guide V0.1 – Table of Contents¹⁹⁸

Executive Summary	
1. Introduction: Online Seminar Program (OSP)	
2. Elements of a Seminar Description	
1.1 Short Title	
1.2 Long Title.....	
1.3 Duration	
1.4 Target Group	
1.5 Objectives & Benefits	
1.6 Seminar Contents.....	
1.7 Sequence of Seminars: Pre-Seminars, Post-Seminars.....	
1.8 Notes	
1.9 Start First Day / End Last Day	
1.10 Certification Text.....	
1.11 Keywords.....	
1.12 Exemplary Seminar Description:	
2 Elements of a Training Site Description	
2.1 Address, Contacts, Image	
2.2 Maps.....	
2.3 How To Get There By Car – Parking Facilities.....	
2.4 How To Get There By Public Transport – Links	
2.5 Additional Information: City Information, Hotels, Events.	
3 Elements of a Diagram Showing a Sequence of Seminars	

¹⁹⁸ Translated from German.

3.1	Formal And Functional Requirements
3.2	Textual Requirements.....
4	Appendix: Creating High-Quality Web Content
4.1	Writing Text For The Web.....
4.2	Formatting Text For The Web.....
5	Additional Links

Appendix B-8.2: Content Provider Walkthrough

Introduction and Informed Consent Clause

Herzlich Willkommen

Willkommen als Tester des neuen Leitfadens für die Content Erstellung für das Online Seminarprogramm.

Vielen Dank, dass Sie sich die Zeit für uns genommen haben. Wir möchten mit Hilfe dieses Tests herausfinden, inwieweit die momentane Version des Leitfadens bereits Ihren Anforderungen entspricht und ihn basierend auf den Ergebnissen weiter verbessern.

Wir werden mit einem Fragebogen und einem kurzen Interview beginnen. Dann werden wir gemeinsam den Leitfaden durchgehen und überprüfen, ob er Ihren Anforderungen entspricht, ob die Inhalte korrekt sind und Sie durch den Leitfaden bei der Erstellung einer Seminarbeschreibung tatsächlich unterstützt werden. Nach diesem Durcharbeiten des Leitfadens werden wir Sie bitten ein kurzes Feedback in Form eines Fragebogens abzugeben.

Denken Sie bitte daran: **Nicht Sie werden getestet!** Die wertvollsten Hinweise erhalten wir dort, wo Sie Kritikpunkte finden und Ihre persönliche Meinung sagen.

Bitte geben Sie uns so viele Informationen wie möglich, indem Sie während der gesamten Testsitzung immer **laut aussprechen:**

- Was sie gerade tun,
- was Sie vorhaben / denken,
- was Sie gut finden,
- was Sie erwartet hätten,
- was Sie stört / was unklar ist.

Besonders interessant sind für uns **Ihre Ideen zur Verbesserung.**

Sie können sich zusätzlich in diesen Unterlagen Notizen, Häkchen usw. machen sowie Kommentare abgeben. Bevor wir beginnen, bitten wir Sie, die Erklärung zu Schweigepflicht zu unterschreiben.

Haben Sie noch Fragen?

Einverständniserklärung und Schweigepflicht

Sehr geehrte/r Usability-Test Teilnehmer/in,

die Abteilung CT IC 7 der Siemens AG hat Sie um die Teilnahme an einem Usability Test gebeten. Sie werden einen Leitfaden zur Erstellung von Seminarbeschreibungen für das Online Seminarprogramm ansehen und beurteilen und uns damit helfen, ein leicht und gut bedienbares Online Seminarprogramm zu entwickeln.

Einige Schritte des Tests werden wir fotografisch dokumentieren, um einen optimalen Ergebnistransfer zu gewährleisten. Die Daten werden wir selbst aus, stellen sie unseren Auftraggebern zur Verfügung und verwenden sie unter Umständen für wissenschaftliche Zwecke. Unter keinen Umständen erfolgt die Weitergabe Ihres Namens.

Einverständniserklärung

Ich nehme am _____ an einem Usability Test zum Thema „Siemens SBS T&S Online Seminarprogramm“ teil. Ich bin damit einverstanden, dabei fotografiert zu werden.

Datum

Name

Unterschrift

Erklärung zur Schweigepflicht

Ich wurde darüber informiert, dass ich inhaltliche und organisatorische Details der Sitzung sowie der Vor- und Nachbesprechung nicht weitergeben darf. Ich werde mit niemandem über das hier behandelte Thema sprechen und keine Inhalte der Sitzung, auch nicht teilweise, an Dritte weitergeben.

Datum

Name

Unterschrift

5-UD Questionnaire for Content Provider Walkthroughs (in German)

Bitte lesen Sie jede der folgenden Fragen. Alle Fragen beziehen sich auf die Erstellung einer Seminarbeschreibung mit Hilfe des „Leitfadens Content Erstellung“. Als Antworten finden Sie zwei Extremantworten und gleich große Abstufungen zwischen ihnen. Bitte kreuzen Sie diejenige Zahl an, die am ehesten Ihre Einschätzung zwischen den Extremen angibt.

Wie effizient können Sie mit dem LCE (Leitfaden Content Erstellung) eine neue Seminarbeschreibung erstellen?

1 2 3 4 5 6 7 8 9

Schlecht: Der LCE unterstützt mich überhaupt nicht bei meinen Aufgaben.

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Gut: Ich kann meine Aufgaben effizient erledigen.

Mögen Sie den LCE?

	1	2	3	4	5	6	7	8	9	
Nein: Es ist sehr unangenehm, mit dem LCE umzugehen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ja: Ich habe es genossen, mit dem LCE umzugehen.

Konnten Sie den LCE ohne Hilfe benutzen?

	1	2	3	4	5	6	7	8	9	
Nein: Es gab nicht genügend Hinweise zur Benutzung	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ja: Alle Hinweise, die ich benötigte, waren vorhanden.

Hatten Sie das Gefühl, die Erstellung einer Seminarbeschreibung mit dem LCE unter Kontrolle zu haben?

	1	2	3	4	5	6	7	8	9	
Nein: Ich habe das Gefühl, der LCE kontrolliert mich.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ja: Ich habe das Erstellen einer Seminarbeschreibung jederzeit unter Kontrolle.

Denken Sie, dass das Erstellen einer Seminarbeschreibung mit dem LCE leicht zu erlernen ist?

	1	2	3	4	5	6	7	8	9	
Nein: Am Anfang ist der LCE sehr schwierig zu benutzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ja: Es ist sehr einfach, das Erstellen einer Seminarbeschreibung mit dem LCE zu erlernen.

Appendix B-8.3: End User Usability Test*Introduction and Informed Consent Clause (in German)***Herzlich Willkommen**

Willkommen als Tester des neuen Online Seminarprogramms.

Vielen Dank, dass Sie sich die Zeit für uns genommen haben. Wir möchten mit Hilfe des Usability Tests herausfinden, inwieweit der momentane Prototyp bereits Ihren Anforderungen entspricht und ihn basierend auf den Ergebnissen weiter verbessern.

Wir werden mit einem Fragebogen und einem kurzen Interview beginnen. Dann werden Sie gebeten, einzelne Aufgaben auszuführen. Nach Abschluss jeder Aufgabe werden wir Sie bitten ein kurzes Feedback in Form eines Fragebogens abzugeben. Der Test wird durch ein zweites kurzes Interview beendet.

Informationen, die wir Ihnen zur Aufgabebearbeitung darbieten, **können** fehlerhaft sein, um damit Problemsituationen überprüfen zu können.

Da es sich hier um einen Prototypen handelt, kann es auch passieren, dass einige Seiten und Funktionen nur angedeutet werden. An diesen Stellen werden wir Sie darauf hinweisen, was in der realen Anwendung passieren würde.

Denken Sie bitte daran: **Nicht Sie werden getestet!** Die wertvollsten Hinweise erhalten wir dort, wo Sie Kritikpunkte finden und Ihre persönliche Meinung sagen.

Bitte geben Sie uns so viele Informationen wie möglich, indem Sie während der gesamten Teilsitzung immer **laut aussprechen**:

- Was sie gerade tun,
- was Sie vorhaben / denken,
- was Sie gut finden,
- was Sie erwartet hätten,
- was Sie stört / was unklar ist.

Besonders interessant sind für uns **Ihre Ideen zur Verbesserung**.

Sie können sich zusätzlich in diesen Unterlagen Notizen, Häkchen usw. machen sowie Kommentare abgeben. Bevor wir beginnen, bitten wir Sie, die Erklärung zu Schweigepflicht zu unterschreiben.

Haben Sie noch Fragen?

Einverständniserklärung und Schweigepflicht

Sehr geehrte/r Usability-Test Teilnehmer/in,

die Abteilung CT IC 7 der Siemens AG hat Sie um die Teilnahme an einem Usability Test gebeten. Sie werden einige Webseiten ansehen und beurteilen und uns damit helfen, ein leicht und gut bedienbares Online Seminarprogramm zu entwickeln.

Einige Schritte des Tests werden wir fotografisch dokumentieren, um einen optimalen Ergebnistransfer zu gewährleisten. Die Daten werden wir selbst aus, stellen sie unseren Auftraggebern zur Verfügung und verwenden sie unter Umständen für wissenschaftliche Zwecke. Unter keinen Umständen erfolgt die Weitergabe Ihres Namens.

Einverständniserklärung

Ich nehme am _____ an einem Usability Test zum Thema „Siemens SBS T&S Online Seminarprogramm“ teil. Ich bin damit einverstanden, dabei fotografiert zu werden.

Datum

Name

Unterschrift

Erklärung zur Schweigepflicht

Ich wurde darüber informiert, dass ich inhaltliche und organisatorische Details der Sitzung sowie der Vor- und Nachbesprechung nicht weitergeben darf. Ich werde mit niemandem über

das hier behandelte Thema sprechen und keine Inhalte der Sitzung, auch nicht teilweise, an Dritte weitergeben.

Datum

Name

Unterschrift

5-UD Questionnaire for End User Usability Tests (in German)

Bitte lesen Sie jede der folgenden Fragen. Alle Fragen beziehen sich an dieser Stelle auf die Aufgabe, die Sie gerade bearbeitet haben. Als Antworten finden Sie zwei Extremantworten und gleich große Abstufungen zwischen ihnen. Bitte kreuzen Sie diejenige Zahl an, die am ehesten Ihre Einschätzung zwischen den Extremen angibt.

Wie effizient können Sie mit dem System arbeiten?

	1	2	3	4	5	6	7	8	9	
Schlecht: Das System hat mich überhaupt nicht bei meinen Aufgaben unterstützt.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Gut: Ich kann meine Aufgaben effizient erledigen.

Mögen Sie das System?

	1	2	3	4	5	6	7	8	9	
Nein: Es ist sehr unangenehm, mit dem System umzugehen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ja: Ich habe es genossen, mit dem System umzugehen.

Könnten Sie das System ohne Hilfe benutzen?

	1	2	3	4	5	6	7	8	9	
Nein: Es gab nicht genügend Hinweise zur Bedienung.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ja: Alle Hinweise, die ich benötigte, waren vorhanden.

Hatten Sie das Gefühl, die das System unter Kontrolle zu haben?

	1	2	3	4	5	6	7	8	9	
Nein: Ich hatte das Gefühl, das System kontrolliert mich.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ja: Ich hatte das System jederzeit unter Kontrolle.

Denken Sie, dass das System leicht zu erlernen ist?

	1	2	3	4	5	6	7	8	9	
Nein: Am Anfang ist es sehr schwierig zu benutzen.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Ja: Es ist sehr einfach, das System zu erlernen.

Appendix B-8.4: Detailed Process Flow During Prototyping and Summative Testing

For each of the methods applied in the Prototyping phase, input was drawn from various sources:

*For the **Content Development Guide V0.1**:*

- Content Requirements Collection (list of textual and formal content requirements collected so far as key input)
- ERD Data Modeling (formal content requirements, metadata schemes, controlled vocabularies from existing data model)
- Wireframes (mostly from each screen's content, layout, navigation/search, and functionality)
- Visual Design (constraints from each screen's content, layout, typography, icons, and images)
- OSP Prototype V0.1 (mostly from each screen's content, layout, navigation/search, and functionality)

*For the **OSP Prototype V0.1**:*

- Content Requirements Collection (mostly content requirements regarding granularity of content affected layout of individual screens)
- ERD Data Modeling (constraints from existing data model)
- Wireframes (specification of content, functionality, navigation/search, and overall layout for each screen of the prototype)
- Visual Design (layout constraints from icons and images)
- Content Development Guide V0.1 (mostly content requirements regarding granularity of content affected layout of individual screens)

*For **ERD Data Modeling**:*

- Content Development Guide V0.1 (content requirements required existing database counterpart)
- OSP Prototype V0.1 (content, layout, navigation/search, and functionality specifications for each screen required existing database counterpart)

For Visual Design:

- Content Development Guide V0.1 (mostly content requirements regarding granularity of content affected visual layout of individual screens)
- OSP Prototype V0.1 (navigation/search and functionalities of individual screens requiring and affecting design of icons; layout constraints for icons and images)

For Content Provider Walkthroughs:

- Content Development Guide V0.1 (stimulus material for the walkthrough)
- End User Usability Tests (content requirements drawn from usability problems found in the end user tests, for evaluation with content providers)

For End User Usability Tests:

- OSP Prototype V0.1 (stimulus material for the usability test)
- Content Provider Walkthroughs (initially planned: potential modifications to the OSP Prototype drawn from the content provider walkthroughs, for evaluation with end users; due to postponed walkthrough sessions not possible)

Appendix B-9: Step 7: Validation Project - Phase 5: Revision and Documentation

Appendix B-9.1: IA Style Guide V1.0 – Table of Contents¹⁹⁹

Introduction	
Data Basis for the Design Specification	
OSP Requirements Analysis	
Siemens Corporate Online Style Guide	
Design Specification	
Homepage	
Seminar Catalog & Seminar Description	
Interaction Flow for Booking a Seminar	
Simple Booking	
Complex Booking	
History of Bookings	
Advanced Search	
Setting up an Account	
Additional Screens	

¹⁹⁹ Translated from German.

Annex.....

Appendix B-9.2: Detailed Process Flow During Documentation

For each of the methods applied in the Documentation phase, input was drawn from various sources:

For Content Development Guide V0.2-09:

- Content Development Guide V0.1 (data basis)
- Content Provider Walkthroughs (results from the walkthroughs as a basis for revision)
- End User Usability Tests (results from the usability tests as a basis for revision)
- ERD Data Modeling (constraints from existing data model)
- Visual Design (constraints from each screen's content, layout, typography, icons, and images)
- OSP Prototype V0.2 (mostly from each screen's content, layout, navigation/search, and functionality)

For OSP Prototype V0.2-0.9:

- OSP Prototype V0.1 (data basis)
- Content Provider Walkthroughs (results from the walkthroughs as a basis for revision)
- End User Usability Tests (results from the usability tests as a basis for revision)
- ERD Data Modeling (constraints from existing data model)
- Visual Design (layout constraints from icons and images)
- Content Development Guide V0.2 (mostly content requirements regarding granularity of content affecting layout of individual screens)

For ERD Data Modeling:

- Content Development Guide V0.2 (content requirements required existing database counterpart of)
- OSP Prototype V0.2 (content, layout, navigation/search, and functionality specifications for each screen required existing database counterpart)

For Visual Design:

- Content Development Guide V0.2 (mostly content requirements regarding granularity of content affected visual design of individual screens)
- OSP Prototype V0.2 (navigation/search and functionalities of individual screens requiring and affecting design of icons; layout constraints for icons and images)

- For the *IA Style Guide V1.0*:
- Content Development Guide V1.0 (identify inconsistencies, align in detail)
- OSP Prototype V0.2 (data basis for the V1.0)
- OSP Prototype V1.0 (identify inconsistencies, align in detail)

For the *Content Development Guide V1.0*:

- Content Development Guide V0.2 (data basis for the V1.0)
- IA Style Guide V1.0 (identify inconsistencies, align in detail)
- OSP Prototype V1.0 (identify inconsistencies, align in detail)

For the *OSP Prototype V1.0*:

- Content Development Guide V1.0 (remove inconsistencies, align in detail)
- IA Style Guide V1.0 (identify inconsistencies, align in detail)
- For the *Final Results Presentation*:
- Content Development Guide V1.0 (data basis for the presentation)
- IA Style Guide V1.0 material (data basis for the presentation)
- OSP Prototype V1.0 (data basis for the presentation)

Appendix B-10: Step 8: Redesign of IA Process Model: Re-rated IA Methods

Method	SC1: IA Process Phase						SC2 - SC4			
Selection Criteria: SC1: Applicability in process phase # SC2: Resources needed (1-5) SC3: End user participation necessary (y/n) SC4: Necessary UCD experience (1-5)	0 Discovery	1 Analysis	2 Design & Prototyp.	3 Evaluation	4 Documentation	5 Implementation	6 Maintenance	SC2 (1-5)	SC3 (y/n)	SC4 (1-5)
Focus Group / Group Discussion			x	x						
Interface Design Patterns			x							
Interview				x						
Participatory Design			x							
Prototyping			x							
Paper Prototyping			x	x						
Video Prototyping			x	x						
Computer-based (Rapid) Pt			x	x						
Wire frame Prototyping			x	x						
Questionnaire				x						
Scenario building exercise			x							
Storyboarding			x	x						
(Usability) Inspection				x						
Heuristic evaluation				x						

Guideline reviews			x	x						
Standards inspections				x						
Formal Usability inspection				x						
Consistency inspections				x						
Human performance models				x						
(Usability) Test				x						
Performance measurement				x						
Co-operative evaluation				x						
Wizard of Oz technique				x						
Walkthrough				x						
Pluralistic Walkthrough				x						
Cognitive Walkthrough				x						
Usability Walkthrough				x						
Brainstorming			x							
Entity Relationship Diagrams		x	x			x	x	x	2,5	n
Blueprints (sitemaps & flowcharts)		x	x	x		x	x		3	y

Appendix C: Final Results

Appendix C-1: LUCIA Process Step Specification

0.1 Identify Business Context

Description:

- Focus: analysis of the sponsoring organization's context of conducting its business
- Scope: products; business domain, model, volume, goals, needs/constraints; mission& vision; unique selling points; employees; locations; major clients; competitors
- Rationale: ensure future site's IA accounts for business context & supports business goal achievement

Input:

n.a.

Alignment with:

0.2 Specify Site Characteristics
0.3 Set Up Project

Methods:

- Affinity Diagramming
- Inquiry methods: Interview methods w/ stakeholders
- Workshop methods
- [Kick-off workshop]

Documented Knowledge:

- "Mission&Vision" of the sponsoring organization
- Any additional documentation available about the organization

Roles:

Responsible	/	Involved
—		●
Project sponsor		
●		—
Project Manager		
—		●
Information Architect		
—		—
Content Manager		
—		—
System Developer		
—		—
Visual/UI-Designer		
—		●
Sales/Marketing		
—		—
Usability Engineer		
—		—
(Content Providers)		
—		—
(End Users)		
—		—
(Others)		

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Business context:
- Business characteristics (products & business domain; business model, volume; mission&vision; unique selling points; employees & locations; major clients)
- Business goals, needs/constraints
- Competitors

Validation Methods:

n.a.

Feedback Loop to:

n.a.

0.2 Specify Site Characteristics

Description:

- Focus: analysis of characteristics of the to-be developed web or intranet site
- Scope: name/version; content & functionality; End User target audience; basic use cases; usage data; site goals; Content Provider; constraints (IT-, CM-, VD-, IA-related)
- Rationale: identify characteristics of & boundary conditions for the site; avoid doubled efforts

Input:

n.a.

Alignment with:

- 0.1 Identify Business Context
- 0.3 Set Up Project

Methods:

- Affinity Diagramming
- Best Practice / Competitive Analysis
- Content Inventory
- Inquiry methods: Interview methods w/ stakeholders; Questionnaires
- User profile / Persona development
- Workshop methods
- [Kick-off workshop]

Documented Knowledge:

- Functional specifications
- Styleguides
- CM Documentation
- Target Audience documentation
- Server Log Data

Output:

Site characteristics:

- Name/version, basic site content & functionality
- End User & Content Provider segments
- Basic use cases & usage data
- Site goals
- Constraints (regarding the site's IT, CM, Branding/VD, IA)

Validation Methods:

n.a.

Roles:

Responsible / Involved

— *Project sponsor* —●
 ● — *Project Manager* —
 — *Information Architect* —●
 — *Content Manager* —●
 — *System Developer* —●
 — *Visual/UI-Designer* —●
 — *Sales/Marketing* —●
 — *Usability Engineer* —●
 — *(Content Providers)* —
 — *(End Users)* —
 — *(Others)* —

Legend:

● responsible/ involved in execution
 ○ responsible/ involved in validation
 () not part of the actual project team
 [] not covered by the process model

Feedback Loop to:

n.a.

0.3 Set Up Project

Description:

- Focus: overall project planning
- Scope: project focus, goals, success criteria; team members & additional stakeholders; work packages; milestones; resources; decision process; risk management
- Rationale: explicitly align project setup with business context and site characteristics; establish consensus on project goals, approach, individual involvement, results

Input:

n.a.

Alignment with:

- 0.1 Identify Business Context
- 0.2 Specify Site Characteristics

Methods:

- Workshop methods
- [Kick-off workshop]
- Inquiry methods: Interview methods w/ stakeholders;

Documented Knowledge:

n.a.

Roles:

Responsible / Involved

— *Project sponsor* —●
 ● — *Project Manager* —
 — *Information Architect* —●
 — *Content Manager* —●
 — *System Developer* —●
 — *Visual/UI-Designer* —●
 — *Sales/Marketing* —●
 — *Usability Engineer* —●
 — *(Content Providers)* —
 — *(End Users)* —
 — *(Others)* —

Legend:

● responsible/ involved in execution
 ○ responsible/ involved in validation
 () not part of the actual project team
 [] not covered by the process model

Feedback Loop to:

n.a.

Output:

- Project setup
- Project focus, goals, success criteria
- Team members & additional stakeholders
- Work packages, milestones, resources, decision process, risk management

Validation Methods:

n.a.

0.4 Document Discovery Results

0.4a Validate

Description:

- Focus: documentation of results of the previous steps; validation by all team members
- Scope: organization's business context; site characteristics; project setup
- Rationale: validated starting point for the project, agreed upon by all team members

Input:

- 0.1 Business context
- 0.2 Site characteristics
- 0.3 Project setup

Alignment with:

n.a.

Methods:

- n.a.

Documented Knowledge:

- n.a.

Roles:

Responsible	/	Involved
—	Project sponsor	—○
●○	Project Manager	—
—	Information Architect	—○
—	Content Manager	—○
—	System Developer	—○
—	Visual/UI-Designer	—○
—	Sales/Marketing	—○
—	Usability Engineer	—○
—	(Content Providers)	—
—	(End Users)	—
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Business Brief including information on:
- Business Context
- Site Characteristics
- Project Setup

Validation Methods:

- Workshop methods:
Focus group / Group discussion; Stakeholder meeting
- [Review of Business Brief]

Feedback Loop:

0.4a → 0.4
0.4a → 0.1-0.3

1.1 Analyze Competitors

Description:

- Focus: analysis of competitor sites; best practices and pitfalls
- Scope: competitor site's content & functionality; content structure & interaction flows; navigation, search, and labeling systems; page layouts
- Rationale: identify competitors' strengths & weaknesses & thus enable the future site's IA to contribute to a competitive edge over competitors; avoid repeating competitors' mistakes & thus unnecessary design/evaluation iterations; learn from competitors' best practices & avoid unnecessary design effort ("don't reinvent the wheel")

Input:

- 0.4 Business goals, site characteristics, competitors

Alignment with:

- 1.2 Analyze Application's Actual State
- 1.3 Analyze End Users' Context of Use
- 1.4 Analyze Content Providers' Context of Use

Methods:

- Best Practice / Competitive Analysis
- Content Inventory
- Inspection methods:
Heuristic evaluation
- Testing methods
- Workshop methods:
Focus group / Group discussion; Stakeholder meeting

Documented Knowledge:

- n.a.

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
●	Information Architect	—
—	Content Manager	—
—	System Developer	—
—	Visual/UI-Designer	—
—	Sales/Marketing	—
●	Usability Engineer	—
—	(Content Providers)	—
—	(End Users)	—●
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Competitor best practices and pitfalls regarding:
- Content & functionality
- Content structure & interaction flows
- Navigation, search, and labeling systems
- Page layouts

Validation Methods:

- n.a.

Feedback Loop to:

n.a.

1.4 Analyze Content Providers' Context of Use

Description:

- Focus: analysis of Content Providers' context of use for the site & its Content Management (CM) process
- Scope: Content Provider attributes (user roles, personas); goals; tasks & success criteria; task flows; use cases / scenarios for the CM Process; technical, physical, & social environment
- Rationale: enable the future site's IA to support CM System usability for content providers, site usability for end users, & business goal achievement by explicitly accounting for vital characteristics of content providers, their environment, & the CM process

Input:

0.4 Site characteristics:
Content Provider segments

Documented Knowledge:

- n.a.

Alignment with:

- 1.1 Analyze Competitors
- 1.2 Analyze Application's Actual State
- 1.3 Analyze End Users' Context of Use

Methods:

- Consolidated Assessment
- Critical Incident Technique
- Diary Keeping
- Field study
- Inquiry methods:
- Scenario building exercise
- Task allocation chart
- Usability Context Analysis
- User Profile analysis/ Persona development
- Workshop methods:
- Focus group/ G.discussion w/ content providers

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
●		Information Architect
—		Content Manager
—		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
●		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

n.a.

Output:

Content Providers' Context of Use:

- Content Provider attributes > user roles > Personas
- CM Process overview: Content Provider goals, tasks & success criteria; task flows, use cases / scenarios
- Content Providers' technical, physical, and social environment

1.5 Gather End User Requirements

Description:

- Focus: analysis of End User requirements for the site
- Scope: requirements regarding the site's content & functionality; content structure & interaction flows; navigation, search, & labeling systems; page layout
- Rationale: enable the future site's IA to support usability for end users & business goal achievement by explicitly accounting for vital end user requirements regarding the site

Input:

- 1.3 Context of Use (End User)
- 1.1 Competitor best practices and pitfalls
- 1.2 Application's actual state & improvement potentials

Documented Knowledge:

- n.a.

Alignment with:

- 1.6 Gather Content Provider Requirements
- 1.1 Analyze Competitors
- 1.2 Analyze Application's Actual State

Methods:

- Card Sorting
- Consolidated Assessment
- Critical Incident Technique
- Diary Keeping
- End User Feedback Anal.
- Field study
- Free Listing
- Inquiry methods
- Log analysis / WUM
- Participatory Design
- Prioritization exercise
- Scenario building exercise
- Testing methods
- Usability Context Analysis
- User Profile/Persona dev.
- Walkthrough methods
- Workshop methods

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
●		Information Architect
—		Content Manager
—		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
●		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

n.a.

Output:

End User requirements regarding the site's:

- Content & functionality
- Content structure & interaction flows
- Navigation, search, & labeling systems
- Page layout

1.6 Gather Content Provider Requirements

Description:

- Focus: analysis of Content Provider requirements for the site
- Scope: requirements regarding the site's content & functionality; data model; content structure & interaction flows; navigation, search, & labeling systems; page layout
- Rationale: enable the future site's IA to support CMS usability for content providers, thus site usability for end users, and thus business goal achievement by explicitly accounting for content provider requirements regarding the site

Input:

- 1.4 Context of Use (Content Provider)
- 1.1 Competitor best practices and pitfalls
- 1.2 Application's actual state & improvement potentials

Documented Knowledge:

- n.a.

Alignment with:

- 1.5 Gather End User Requirements
- 1.1 Analyze Competitors
- 1.2 Analyze Application's Actual State

Methods:

- Card Sorting
- Consolidated Assessment
- Critical Incident Technique
- Diary Keeping
- Field study
- Free Listing
- Inquiry methods
- Log analysis / WUM
- Participatory Design
- Prioritization exercise
- Scenario building exercise
- Testing methods: Card-based classification evaluation; Structure evaluation
- Usability Context Analysis
- User Profile/Persona dev.
- Walkthrough methods
- Workshop methods

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
●	Information Architect	—
●	Content Manager	—
—	System Developer	—
—	Visual/UI-Designer	—
—	Sales/Marketing	—
●	Usability Engineer	—
—	(Content Providers)	●
—	(End Users)	—
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

n.a.

1.7 Document Analysis Results

1.7a Validate

Description:

- Focus: documentation of results of the previous steps; validation by all team members
- Scope: Competitor best practices & pitfalls; site's actual state & improvement potentials; End Users' & Content Providers context of use & requirements
- Rationale: summary of analysis data available for the design of the IA, agreed upon by all team members

Input:

- 1.1 Competitor best practices & pitfalls
- 1.2 Application's actual state & improvement potentials
- 1.3 End Users' Context of Use
- 1.4 Content Providers' Context of Use
- 1.5 End User requirements
- 1.6 Content Provider requirements

Alignment with:

n.a.

Methods:

- Affinity Diagramming
- Blueprints

Roles:

Responsible	/	Involved
—	Project sponsor	○
○	Project Manager	○
●	Information Architect	—
●	Content Manager	—
—	System Developer	○
—	Visual/UI-Designer	○
—	Sales/Marketing	○
●	Usability Engineer	—
—	(Content Providers)	—
—	(End Users)	—
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

1.7a → 1.7
1.7a → 1.1-1.4

Output:

- IA Analysis Results Report including:
 - Competitor best practices and pitfalls
 - Site's actual state and improvement potentials
 - End Users' & Content Providers' Context of Use
 - End User and Content Provider requirements

Validation Methods:

- Workshop methods: Stakeholder meeting
- [Review of IA Analysis Results Report]

2.1 Prioritize Features/Phase Project/Develop Strategy

2.1a Validate

Description:

- Focus / scope: (1) prioritization of content & functionality features; (2) phasing of their implementation; (3) development of an overall IA design strategy (focus/ scope/ deliverables of the IA design; approach: bottom-up vs. top-down; methods to be used)
- Rationale: detailed plan for subsequent design activities, agreed upon by all team members

Input:

1.7 IA Analysis Results

Alignment with:

n.a.

Methods:

- Affinity Diagramming
- Free Listing
- Interview methods w/ stakeholders
- Prioritization Exercise
- Scenario Building Exercise
- Workshop methods: Focus Group/G.discussion w/ stakeholders; Stakeholder meeting

Documented Knowledge:

- n.a.

Roles:

Responsible	/	Involved
—		Project sponsor —●
●—		Project Manager —
●—		Information Architect —
—		Content Manager —●
—		System Developer —●
—		Visual/UI-Designer —●
—		Sales/Marketing —●
—		Usability Engineer —●
—		(Content Providers) —
—		(End Users) —
—		(Others) —

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Content / functionality features, prioritized according to feasibility & relevance
- Roadmap for the project and subsequent efforts
- Overall strategy for (re-)designing the site's information architecture

Validation Methods:

- Workshop methods: Focus group/G.discussion w/ stakeholders; Stakeholder meeting
- Interview methods w/ stakeholders

Feedback Loop to:

2.1a → 2.1
2.1a → 1.1-1.4

2.2 Collect Formal & Semantic Content Requirements

2.2a Validate

Description:

- Focus: collecting requirements for the content of the future site
- Scope: formal (e.g., length; bullet-points vs. continuous text) & semantic (e.g., language level; controlled vocabularies) requirements for all content types of the future site
- Rationale: identify content requirements for the site which support high usability for end users, business goal achievement, and practicability for content providers; establish a starting point for the to-be developed Content Development Guide

Input:

1.7 IA Analysis Results
2.1 Prioritized content & functionality features, overall strategy

Alignment with:

2.3. Content Modeling
2.4 Define Content Structure & Interaction Flows
2.5 Define Navigation & Search Systems
2.6 Define layout templates & Interface Design
2.7 Define Visual Design
2.8 Data Modeling
2.9 Evaluate Wireframes

Methods:

- Inquiry methods: Interview methods with Content Manager and IT Dev.
- [Derive requirements from styleguides]

Documented Knowledge:

- Styleguides

Roles:

Responsible	/	Involved
—		Project sponsor —
—		Project Manager —
●—		Information Architect —
—		Content Manager —●
—		System Developer —●
—		Visual/UI-Designer —
—		Sales/Marketing —
—		Usability Engineer —
—		(Content Providers) —
—		(End Users) —
—		(Others) —

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Formal & semantic content requirements for all content types of the future site

Validation Methods:

- Inspection methods: Consistency inspection, Guideline reviews / Standards inspection
- Inquiry methods: Interview methods with Content Manager and IT Dev.

Feedback Loop to:

2.2a → 2.2

2.3 Content Modeling

Description:

- Focus: defining content elements for the future site
- Scope: required types of content; formal and semantic qualities for each; relationships between elements; metadata schemata for content type classes
- Rationale: define basic characteristics of the site's content to support high usability for end users and business goal achievement; establish a starting point for detailed data modeling

Input:

- 1.7 IA Analysis Results
- 2.1 Prioritized content & functionality features, overall strategy

Documented Knowledge:

- n.a.

Alignment with:

- 2.2 Collect Formal & Semantic Content Requirements
- 2.4 Define Content Structure & Interaction Flows
- 2.5 Define Navigation & Search Systems
- 2.6 Define layout templates & Interface Design
- 2.7 Define Visual Design

Methods:

- Affinity Diagramming
- Card Sorting

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
●		Information Architect
—		Content Manager
—		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Content model for the future site:
- Content type classes, including metadata schemata
- Formal (e.g. length, media type) and semantic content qualities (e.g., scope, granularity, wording, style)
- Relationships between content types

Validation Methods:

- n.a.

Feedback Loop to:

n.a.

2.4 Define Content Structure & Interaction Flows

2.4a Validate

Description:

- Focus / scope: structure of content at inter-page level; sequence of steps (pages) within an interaction flow
- Rationale: develop content structure & interaction flows which support high usability for end users and business goal achievement

Input:

- 1.7 IA Analysis Results
- 2.1 Prioritized content & functionality features, overall strategy
- 2.3 Basic content model

Documented Knowledge:

- Styleguides

Alignment with:

- 2.2 Collect Formal and Semantic Content Requirements
- 2.3. Content Modeling
- 2.5 Define Navigation & Search Systems
- 2.6 Define layout templates & Interface Design
- 2.7 Define Visual Design
- 2.8 Data Modeling

Methods:

- Blueprints (organization & interaction documentation)
- Parallel Design
- Participatory Design
- Scenario Building Exercise
- Storyboarding

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
●		Information Architect
—		Content Manager
—		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
○		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Blueprints detailing the future site's:
- content structure
- interaction flows

Validation Methods:

- Inspection methods
- Testing methods: Card-based classification evaluation; Co-operative evaluation; Structure evaluation
- Walkthrough methods

Feedback Loop to:

2.4a → 2.4

2.5 Define Navigation & Search Systems

2.5a Validate

Description:

- Focus/ scope: design of embedded and supplemental navigation systems; design of query input and results display (incl. ranking / sorting & clustering of results); definition of search engine components (query languages, query operations, indices)
- Rationale: design navigation & search mechanisms which support high usability for end users, business goal achievement, and practicability for content providers; alignment of database / search engine design and search interface design

Input:

- 1.7 IA Analysis Results
- 2.1 Prioritized content & functionality features, overall strategy
- 2.4 Blueprints

Documented Knowledge:

- Styleguides

Alignment with:

- 2.2 Collect Formal and Semantic Content Requirements
- 2.3. Content Modeling
- 2.4 Define Content Structure & Interaction Flows
- 2.6 Define layout templates & Interface Design
- 2.7 Define Visual Design
- 2.8 Data Modeling

Methods:

- Interface Design Patterns
- Parallel Design
- Participatory Design
- Prototyping methods: Paper Prototyping; Wireframe Prototyping
- Scenario Building Exercise
- Storyboarding

Validation Methods:

- Inspection methods
- Storyboarding
- Testing methods: Card-based classification evaluation; Co-operative evaluation; Structure evaluation; Usability Test; Wizard of Oz technique
- Walkthrough methods

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
●	Information Architect	—
—	Content Manager	—
●	System Developer	—
—	Visual/UI-Designer	●
—	Sales/Marketing	—
○	Usability Engineer	●
—	(Content Providers)	—
—	(End Users)	●○
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

2.5a → 2.5

Output:

- Wireframe components:
 - Embedded navigation: global, local, contextual systems
 - Supplemental navigation: sitemaps, guides, wizards
 - Search interface (query input; results display)
- Definition of search engine components

2.6 Define Layout Templates & Interface Design

2.6a Validate

Description:

- Focus / scope: structure of content at intra-page level (layout templates for major page types: content; navigation; search query input and results display pages); design of user interface elements for each page
- Rationale: design layout templates and interface design for each page which support high usability for end users and business goal achievement

Input:

- 1.7 IA Analysis Results
- 2.1 Prioritized content & functionality features, overall strategy

Documented Knowledge:

- Styleguides

Alignment with:

- 2.2 Collect Formal and Semantic Content Requirements
- 2.3. Content Modeling
- 2.4 Define Content Structure and Interaction Flows
- 2.5 Define Navigation & Search Systems
- 2.7 Define Visual Design
- 2.8 Data Modeling

Methods:

- Interface Design Patterns
- Parallel Design
- Participatory Design
- Prototyping methods: Paper Prototyping; Wireframe Prototyping
- Storyboarding
- Workshop methods: Brainstorming

Validation Methods:

- Inspection methods
- Storyboarding
- Walkthrough methods

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
●	Information Architect	○
—	Content Manager	—
—	System Developer	—
●○	Visual/UI-Designer	—
—	Sales/Marketing	—
○	Usability Engineer	●
—	(Content Providers)	—
—	(End Users)	●○
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

2.6a → 2.6

Output:

- Wireframe components:
 - layout templates and
 - user interface design for each page

2.7 Develop Online Branding / Visual Design

2.7a Validate

Description:

- Focus / scope: Strategic brand concept (key brand benefit, desired brand values & personality, verbal and visual brand concept, tonality); brand name; brand design (key visuals, logotype, typography, color schemes, visual appearance of layout grids; navigation, search, & additional graphical interface elements);
- Rationale: develop online branding and visual design for the site which supports high usability for end users and business goal achievement

Input:

- 1.7 IA Analysis Results
- 2.1 Prioritized content & functionality features, overall strategy

Documented Knowledge:

- Styleguides

Alignment with:

- 2.2 Collect C.Requirements
- 2.3. Content Modeling
- 2.4 Define Content Structure & Interaction Flows
- 2.5 Define Nav. & Search S.
- 2.6 Define layout templates & Interface Design
- 2.8 Data Modeling
- 2.10 Develop C. Dev.Guideline
- 2.11 Develop SitePrototype

Methods:

- Interface Design Patterns
- Parallel Design
- Participatory Design
- Prototyping methods: Computer-based (rapid) prototyping; Paper Prototyping; Wireframe Prototyping.
- Storyboarding
- Workshop methods: Brainstorming

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
—		Information Architect ●○
—		Content Manager
—		System Developer
●○		Visual/UI-Designer
○		Sales/Marketing
○		Usability Engineer
—		(Content Providers)
—		(End Users) ●○
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Strategic brand concept
- Wireframe components:
 - Brand name;
 - Brand / visual design

Validation Methods:

- Inspection methods
- Storyboarding
- Walkthrough methods
- [analysis of denotation and connotation spectrum, and acceptance level]

Feedback Loop to:

2.7a → 2.7

2.8 Data Modeling

Description:

- Focus / scope: modeling data entities, attributes, and relationships between entities (conceptual, logical, and physical database design, including data normalization; no database implementation yet)
- Rationale: align data model with characteristics of the future site and its content; allow for efficient technical implementation of the IA; enable data model to support high usability for end users, business goal achievement, and practicability for content providers

Input:

- 2.3 Content Model

Documented Knowledge:

- n.a.

Alignment with:

- 2.2 Collect C. Requirements
- 2.4 Define Content Structure & Interaction Flows
- 2.5 Define Nav. & Search S.
- 2.6 Define layout templates & Interface Design
- 2.7 Define Visual Design
- 2.9 Evaluate Wireframes
- 2.10 Develop Content Development Guide
- 2.11 Develop Site Prototype

Methods:

- Affinity Diagramming
- Blueprints (organization & interaction doc.)
- Entity Relationship Diagrams

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
●		Information Architect
—		Content Manager
●		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Data Model:
 - Entities
 - Attributes, Controlled Vocabularies
 - Relationships

Validation Methods:

- n.a.

Feedback Loop to:

n.a.

2.9 Evaluate Blueprints & Wireframes

Description:

- Focus / scope: evaluation of content structure, interaction flows, navigation / search systems, layout, interface design, (and visual design, as far as applicable)
- Rationale: identify strengths and weaknesses of the design as early as possible; ensure design of wireframes supports high usability for end users and business goal achievement

Input:

2.4: Blueprints
2.5-2.7: Wireframes (2.5: Navigation & search systems; 2.6: Layout templates & user interface design; 2.7: visual brand design)

Documented Knowledge:

- Styleguides

Alignment with:

n.a.

Methods:

- Inquiry methods: Interview methods; Questionnaire
- Inspection methods
- Storyboarding
- Testing methods: Card-based classification evaluation, Co-operative evaluation; Structure evaluation, Usability Test, Wizard of Oz technique
- Walkthrough

Roles:

Responsible	/	Involved
—		—
—	<i>Project sponsor</i>	—
—	<i>Project Manager</i>	—
—	<i>Information Architect</i>	—
—	<i>Content Manager</i>	—
—	<i>System Developer</i>	—
—	<i>Visual/UI-Designer</i>	—
—	<i>Sales/Marketing</i>	—
●	<i>Usability Engineer</i>	—
—	<i>(Content Providers)</i>	—
—	<i>(End Users)</i>	●
—	<i>(Others)</i>	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

Evaluated Wireframes:
▪ Strengths and
▪ Improvement potentials

Validation Methods:

▪ n.a.

Feedback Loop to:

2.9 → 2.4-2.7

2.10 Develop Content Development Guide

Description:

- Focus / scope: documenting formal and Semantic content requirements to be met by content providers in terms of standards/ guidelines/ recommendations; including best practices; examples;
- Rationale: translate database and site characteristics relevant for content providers into requirements for them to enable efficient content development; thus ensure efficient high-quality content across content providers and over time

Input:

2.2 Formal & Semantic Content Requirements

Documented Knowledge:

- Styleguides

Alignment with:

2.7 (cont.) Develop Visual Design
2.8 Data Modeling
2.11 Develop Site Prototype

Methods:

▪ n.a.

Roles:

Responsible	/	Involved
—		—
—	<i>Project sponsor</i>	—
—	<i>Project Manager</i>	—
●	<i>Information Architect</i>	—
●	<i>Content Manager</i>	—
—	<i>System Developer</i>	—
—	<i>Visual/UI-Designer</i>	—
—	<i>Sales/Marketing</i>	—
—	<i>Usability Engineer</i>	—
—	<i>(Content Providers)</i>	—
—	<i>(End Users)</i>	—
—	<i>(Others)</i>	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

▪ Content Development Guide V0.1

Validation Methods:

▪ n.a.

Feedback Loop to:

n.a.

2.11 Develop Site Prototype

Description:

- Focus / scope: prototyping the site; level of fidelity / interactivity, medium, and horizontal / vertical detail of the prototype according to project and site goals
- Rationale: allow for comprehensive evaluation of the IA in subsequent testing; provide a starting point for implementation

Input:

2.9 Evaluated Wireframes

Alignment with:

2.7 (cont.) Develop Visual Design
2.8 Data Modeling
2.10 Develop Content Development Guide

Methods:

- Prototyping methods
- Storyboarding

Documented Knowledge:

- Styleguides

Output:

- Site Prototype V0.1

Validation Methods:

- n.a.

Roles:

Responsible	/	Involved
—		—
—		—
—		—
●		—
—		—
●		—
—		—
—		—
—		—
—		—
—		—
—		—
—		—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

n.a.

3.1 Evaluate Content Development Guide

Description:

- Focus / scope: evaluation of accuracy and practicability of standards/ guidelines/ recommendations (including best practices & examples) as specified in Content Development Guide (CDG) V0.1
- Rationale: identify strengths and weaknesses of the CDG V0.1; ensure high accuracy and practicability of CDG V0.1 for content providers

Input:

2.10 Content Development Guide V0.1

Alignment with:

3.2 Evaluate Site Prototype

Methods:

- Inquiry methods: Interview methods; Questionnaire
- Storyboarding
- Walkthrough methods
- Workshop methods: Focus group/G. discussion
- [Testing methods only applicable if CDG is implemented in a Content Management System to be tested with content providers]

Documented Knowledge:

- n.a.

Output:

- Content provider feedback for CDG V0.1:
- Strengths and
- Improvement potentials

Roles:

Responsible	/	Involved
—		—
—		—
—		—
—		—
—		—
—		—
—		—
●		—
—		—
—		—
—		—
—		—
—		—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

3.1 → 2.10
3.1 → 2.1
3.1 → 1.1-1.4

3.2 Evaluate Site Prototype

Description:

- Focus / scope: evaluation of the usability of the site prototype; focus and scope of the evaluation in accordance with project and site goals
- Rationale: ensure prototype supports high usability for end users and business goal achievement

Input:

2.11 Site Prototype V0.1

Alignment with:

3.1 Evaluate Content Development Guide

Methods:

- Inquiry methods: Interview methods; Questionnaire
- Inspection methods
- Storyboarding
- Testing methods
- Workshop methods: Focus group/G. discussion
- Walkthrough methods

Documented Knowledge:

- Styleguides

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
—		Information Architect
—		Content Manager
—		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
●		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- End user feedback for site prototype V0.1:
- Strengths and
- Improvement potentials

Validation Methods:

n.a.

Feedback Loop to:

3.2 → 2.11
3.2 → 2.1
3.2 → 1.1-1.4

4.1 Revise Content Development Guide

Description:

- Focus / scope: revision, refinement & completion of standards/ guidelines/ recommendations (including best practices & examples)
- Rationale: incorporate content provider & end user feedback into Content Development Guide (CDG), thus ensuring high accuracy and practicability of CDG for content providers; align CDG with revised data model, site prototype, and Visual Design;

Input:

3.1 Content provider feedback for CDG V0.1
3.2 End user feedback for site prototype V0.1

Alignment with:

4.2 Revise Data Model
4.3 Revise Site Prototype
4.4 Revise Visual Design

Methods:

- n.a.

Documented Knowledge:

- n.a.

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
●		Information Architect
●		Content Manager
—		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Revised Content Development Guide (V0.2-0.9)

Validation Methods:

- n.a.

Feedback Loop to:

n.a.

4.2 Revise Data Model

Description:

- Focus / scope: revision of data entities, attributes, and relationships between entities
- Rationale: align data model with content provider & end user feedback, thus ensuring data model supports high usability for end users, business goal achievement, and practicability for content providers; align data model with revised CDG, site prototype, and Visual Design;

Input:

- 2.8 Data Model
- 3.1 Content provider feedback for CDG V0.1
- 3.2 End user feedback for site prototype V0.1

Alignment with:

- 4.1 Revise Content Development Guide
- 4.3 Revise Site Prototype
- 4.4 Revise Visual Design

Methods:

- Affinity Diagramming
- Blueprints (organization & interaction doc.)
- Entity Relationship Diagrams

Documented Knowledge:

- n.a.

Output:

Revised Data Model:

- Entities
- Attributes, Controlled Vocabularies
- Relationships

Validation Methods:

- n.a.

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
●		Information Architect
—		Content Manager
●		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

n.a.

4.3 Revise Site Prototype

Description:

- Focus / scope: revision & refinement of site prototype;
- Rationale: incorporate content provider & end user feedback into site prototype, thus ensuring high usability for end users and business goal achievement; align site prototype with revised CDG, data model, and Visual Design

Input:

- 3.1 Content provider feedback for CDG V0.1
- 3.2 End user feedback for site prototype V0.1

Alignment with:

- 4.1 Revise Content Development Guide
- 4.2 Revise Data Model
- 4.4 Revise Visual Design

Methods:

- Prototyping methods
- Storyboarding

Documented Knowledge:

- Styleguides

Output:

- Revised Site Prototype (V0.2-0.9)

Validation Methods:

- n.a.

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
●		Information Architect
—		Content Manager
●		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

n.a.

4.4 Revise Online Branding / Visual Design

Description:

- Focus / scope: Revision of strategic brand concept, brand labeling, & brand design; implementation of brand (developing brand copyright documentation, brand design styleguide)
- Rationale: incorporate content provider & end user feedback into Online Branding and Visual Design, thus ensuring both support high usability for end users and business goal achievement; align Online Branding and Visual Design with revised CDG, data model, and site prototype

Input:

- 3.1 Content provider feedback for CDG V0.1
- 3.2 End user feedback for site prototype V0.1

Documented Knowledge:

- Styleguides

Alignment with:

- 4.1 Revise Content Development Guide
- 4.2 Revise Data Model
- 4.3 Revise Site Prototype

Methods:

- Interface Design Patterns
- Parallel Design
- Participatory Design
- Prototyping methods: Computer-based (rapid) prototyping; Paper Prototyping; Wireframe Prototyping
- Storyboarding

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
—	Information Architect	●○
—	Content Manager	—
—	System Developer	—
●○	Visual/UI-Designer	—
○	Sales/Marketing	●
○	Usability Engineer	●
—	(Content Providers)	—
—	(End Users)	●○
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Revised strategic brand concept
- Revised brand name;
- Revised brand / visual design
- Brand implemented:
 - Brand copyright documentation
 - Brand design styleguide

Validation Methods:

- Inspection methods
- Storyboarding
- Walkthrough methods
- [analysis of denotation and connotation spectrum, and acceptance level]

Feedback Loop to:

[4.4 → 4.4]

4.5 Document Final Results

Description:

- Focus / scope: final alignment of Content Development Guide, data model, site prototype, and online branding / visual design; development of IA Specification / Styleguide and final version of Content Development Guide
- Rationale: enable efficient implementation and maintenance of the IA (IA Specification / Styleguide); enable efficient content development, ensure high-quality content across content providers and over time (Content Development Guide)

Input:

- 4.1 Revised Content Development Guide
- 4.2 Revised Data Model
- 4.3 Revised Site Prototype
- 4.4 Revised strategic brand concept, brand labeling, brand / visual design

Documented Knowledge:

- n.a.

Alignment with:

n.a.

Methods:

- n.a.

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
●	Information Architect	—
—	Content Manager	●
—	System Developer	●
—	Visual/UI-Designer	●
—	Sales/Marketing	—
—	Usability Engineer	—
—	(Content Providers)	—
—	(End Users)	—
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Documentation of final IA:
 - IA Specification / IA Styleguide
 - Content Development Guide V1.0

Validation Methods:

- n.a.

Feedback Loop to:

n.a.

5.1 Set up & Start Content Management Process

Description:

- Focus / scope / rationale: setup & start of Content Management Process: authoring & editing content; transferring content to the Content Management System; assigning metadata values to content elements

Input:

4.5 Content Development Guide V1.0

Alignment with:

5.2 Technical Implementation

Methods:

- n.a.

Documented Knowledge:

- n.a.

Output:

- Content management process running
- Content for the site, integrated in the Content Management System:
 - Content elements
 - Metadata for each element

Validation Methods:

- [Editing & Quality Assurance]

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
—		Information Architect
●○		Content Manager
—		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

[5.1 → 5.1]

5.2 Technical Implementation (Front- & Backend)

Description:

- Focus / scope / rationale: conceptual design of hardware & software architecture; implementation of software architecture (Content Management System; software for web & application server; DBMS; development tools); planning, writing, testing, & iteratively revising source code; documenting technical implementation

Input:

4.5 IA Specification / IA Styleguide

Alignment with:

5.1 Set up & Start Content Management Process

Methods:

- Prototyping methods:
 - Computer-base (rapid) prototyping
- Interface Design Patterns
- [Extreme Programming]
- [Software Design Patterns]

Documented Knowledge:

- n.a.

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
—		Information Architect
—		Content Manager
●○		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

[5.2 → 5.2]

Output:

- Front- & backend of the site implemented:
 - Conceptual design of hardware & software architecture
 - Software architecture set up & implemented
 - Source code written & tested (functional & technical)
 - Technical implementation documented (user manual, administration manual)

Validation Methods:

- [code review]
- [functional tests]
- [technical tests]

5.3 Deployment

Description:

- Focus / scope / rationale: implementation of hardware architecture (web-, application-, database server; firewalls; load-balancing; backup/recovery strategies); installation of site on staging server, testing & revising the site (& content); Go-live.

Input:

- 5.1 Content for the site, integrated in the Content Management System
- 5.2 Front- & backend of the site implemented

Documented Knowledge:

- n.a.

Alignment with:

n.a.

Methods:

- n.a.

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
—	Information Architect	○
—	Content Manager	○
●	System Developer	—
—	Visual/UI-Designer	—
—	Sales/Marketing	—
—	Usability Engineer	○
—	(Content Providers)	—
—	(End Users)	—
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Site is live & running:
- Hardware architecture set up & implemented
- Site installed, tested & revised, and ported to its destination environment

Validation Methods:

- [alpha, beta tests]
- [Quality Assurance]

Feedback Loop to:

- [5.3 → 5.2]
- [5.3 → 5.3]

6.1 Measure Success

Description:

- Focus / scope: evaluation of the site with regard to the specified project and site goals.
- Rationale: measure project success in terms of user and business goals and identify improvement potentials

Input:

- 5.3 Site running

Documented Knowledge:

- n.a.

Alignment with:

n.a.

Methods:

- End User Feedback Analysis
- Field study
- Inquiry methods: Interview methods; Questionnaire; Survey
- Inspection methods
- Log Analysis / Web Usage Mining
- Testing methods
- Walkthrough methods
- Workshop methods: Focus Group / Group Discussion
- [Analyzing business figures]

Roles:

Responsible	/	Involved
—	Project sponsor	—
●	Project Manager	—
—	Information Architect	●
—	Content Manager	●
—	System Developer	●
—	Visual/UI-Designer	—
—	Sales/Marketing	—
●	Usability Engineer	—
—	(Content Providers)	●
—	(End Users)	●
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

- 6.1 → 2.1
- 6.1 → 1.1-1.4
- 6.1 → 0.1-0.3

6.2 Content Maintenance / Production

Description:

- Focus / scope: maintenance of content & metadata; authoring & editing content, assigning metadata to content elements
- Rationale: maintain high content quality

Input:

- 4.5 Content Development Guide
- 5.1 Content for the site, integrated in the Content Management System
- 6.1 Success figures & improvement potentials

Documented Knowledge:

- n.a.

Alignment with:

- 6.3 Technical Maintenance
- 6.4 IA Maintenance
- 6.5 Visual Design Maintenance

Methods:

- n.a.

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
—		Information Architect
●		Content Manager
—		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- Content maintained

Validation Methods:

- n.a.

Feedback Loop to:

n.a.

6.3 Technical Maintenance

Description:

- Focus / scope: maintenance of the site's technical architecture & infrastructure; database and Content Management System; data model; page template code and scripts; software testing
- Rationale: maintain proper technical system status

Input:

- 4.5 IA Specification / IA Styleguide
- 5.2 Front-& backend of the site technically implemented
- 6.1 Success figures & improvement potentials

Documented Knowledge:

- n.a.

Alignment with:

- 6.2 Content Maintenance / Production
- 6.4 IA Maintenance
- 6.5 Visual Design Maintenance

Methods:

- n.a.

Roles:

Responsible	/	Involved
—		Project sponsor
—		Project Manager
—		Information Architect
—		Content Manager
●		System Developer
—		Visual/UI-Designer
—		Sales/Marketing
—		Usability Engineer
—		(Content Providers)
—		(End Users)
—		(Others)

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Output:

- IT maintained

Validation Methods:

- n.a.

Feedback Loop to:

n.a.

6.4 IA Maintenance

Description:

- Focus / scope: maintenance of content structure; content model (content elements, relationships, and metadata schema); interaction flows; navigation / search & labeling systems; layout templates; interface design
- Rationale: maintain high quality of IA system

Input:

- 4.5 IA Specification / IA Styleguide
- 6.1 Success figures & improvement potentials

Documented Knowledge:

- Styleguides

Alignment with:

- 6.2 Content Maintenance / Production
- 6.3 Technical Maintenance
- 6.5 Visual Design Maintenance

Methods:

- Card Sorting
- Critical Incident Technique
- End User Feedback Anal.
- Field study
- Inquiry methods
- Inspection methods
- Log Anal./ Web Usage M.
- Prototyping methods
- Storyboarding
- Scenario building exercise
- Testing methods
- Walkthrough methods
- Workshop methods: Brainstorming; Focus Group/G.discussion

Output:

- IA maintained

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
●	Information Architect	—
—	Content Manager	●
—	System Developer	●
—	Visual/UI-Designer	●
—	Sales/Marketing	—
—	Usability Engineer	—
—	(Content Providers)	—
—	(End Users)	—
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

n.a.

6.5 Online Branding / Visual Design Maintenance

Description:

- Focus / scope: maintenance of online branding (strategic brand concept, brand name & design; copyright documentation, & brand design styleguide) & visual design for the site (including key visuals, logotype, typography, color schemes, visual appearance of layout grids; navigation, search, & additional graphical interface elements)
- Rationale: maintain high quality of online branding / visual design

Input:

- 4.5 IA Specification / IA Styleguide
- 6.1 Success figures & improvement potentials

Documented Knowledge:

- Styleguides

Alignment with:

- 6.2 Content Maintenance / Production
- 6.3 Technical Maintenance
- 6.4 IA Maintenance

Methods:

- Inspection methods
- Interface Design Patterns
- Parallel Design
- Participatory Design
- Prototyping methods: Computer-based (rapid) prototyping; Paper Prototyping; Wireframe Prototyping
- Storyboarding
- Walkthrough methods
- Workshop methods: Brainstorming; Focus Group/G.discussion
- [analysis of denotation and connotation spectrum, and acceptance level]

Output:

- Visual design maintained

Roles:

Responsible	/	Involved
—	Project sponsor	—
—	Project Manager	—
—	Information Architect	●
—	Content Manager	—
—	System Developer	—
●	Visual/UI-Designer	—
●	Sales/Marketing	●
—	Usability Engineer	●
—	(Content Providers)	—
—	(End Users)	—
—	(Others)	—

Legend:

- responsible/ involved in execution
- responsible/ involved in validation
- () not part of the actual project team
- [] not covered by the process model

Feedback Loop to:

n.a.

Appendix C-2: IA Method Description List: Description of Methods

Method	Description / Variants
Affinity Diagramming	Affinity diagramming simply consists of placing related items together. Although this can be done electronically for very small sets of data (using a word processor or spreadsheet program), it is better to work with paper. In group situations, always use paper.
Best Practice/Competitive Analysis	Review of the research literature; "professional judgment" usability review of any competitor software, user interfaces, or e-commerce websites.
Blueprints	Blueprints are visual representations of the site structure, documenting the various pages or page types, their relationships, and user paths to and from them. Major types of blueprints include organization documentation blueprints (content-oriented, documenting how static content is organized, labeled, and navigated), and interaction documentation blueprints (task-oriented, documenting interaction flows and dynamic content organization).
Card Sorting	This is a method for discovering the latent structure in an unsorted list of statements or ideas/content elements. The investigator writes each item on a small index card and requests six or more informants to sort these cards into groups or clusters, working on their own. The results of the individual sorts are then combined and if necessary analyzed statistically.
Consolidated Assessment	Combination of scenario building exercise, card sorting, and participatory design into one session
Content Inventory	It is a complete list of all the content that the site holds and will hold. Most typically used for content-centric rather than functionality-centric websites. The content inventory may be provided by the IA or the client.
Critical Incident Technique	End users are asked to identify specific incidents which they experienced personally and which had an important effect on the final outcome. The emphasis is on incidents rather than vague opinions. The context of the incident may also be elicited. Data from many users is collected and analyzed.
Diary keeping	Activity diaries require the informant to record activities they are engaged in throughout a normal day. Diaries may vary from open-ended, where the informant writes in their own words, to highly structured tick-box forms, where the respondent gives simple multiple choice or yes/no answers to questions. The required materials range from paper and pencil techniques, to video tape diaries and on-line input forms administered by computer.
End User Feedback Analysis	Analysis of support call and guest book data of a website.
Entity Relationship Diagrams (ERD)	ERDs are visualizations of data entities to be included in a database, their attributes, and relationships. ERDs typically specify the data that must be captured, stored, and retrieved, as well as the data required to report on specific performance measures.
Field study (observation methods)	Observational methods involve an investigator viewing users as they work in a field study, and taking notes on the activity that takes place. Observation may be either direct, where the investigator is actually present during the task, or indirect, where the task is viewed by some other means such as through use of a video recorder. The method is useful early in user requirements specification for obtaining qualitative data. It is also useful for studying currently executed tasks and processes.
Free Listing	Free-listing is a semi-structured method. It can be conducted as part of an interview, or as a written exercise (and can be done online as well). Simply ask the respondent, "Name all the x's you know." Frequency and rank of items mentioned by several respondents are statistically analyzed.
Functionality matrix	This process specifies the system functions that each user will require for the different tasks that they perform. The most critical task functions are identified so that more time can be paid to them during usability testing later in the design process. It is important that input is obtained from different user groups in order to complete the matrix fully.
Inquiry methods	A set of methods, which, at their core, involve asking respondents a set of questions and recording their answers.
Interview	Respondents are asked questions in a personal dialogue between interviewer and interviewee. Interviews may be unstructured (no predefined questions, no predefined range of possible answers), semi-structured (predefined questions, open answers), or structured (both predefined questions and range of possible answers)

Contextual Inquiry	CI is a field interview that focuses on interviewees' work practice, including their mental models of how something works, their goals, tools and methods, terminology, and the values they are driven by. Although CI can be very time-consuming, it yields a lot of valuable data, especially when analyzing work practices in domains not well known to the team
Task Analysis	Study of what a user is required to do in terms of actions and/or cognitive processes to achieve a task. Gain access to real users to discuss their current or possible future tasks as well as user representatives.
Questionnaire	A set of written or printed questions handed over to the respondent. Thus, there is no need for the analyst to be present during its completion. Questionnaires may be closed (providing a range of possible answers to each questions) or open (no range of answers provided)
Survey	Administering a set of (not necessarily printed) questions to a large sample population of users.
Inspection methods	A set of methods also referred to as expert-based evaluations of a product, as their common denominator is the idea that usability experts examine or work with a system in an effort to detect potential usability problems.
Consistency inspections	Representatives from the user interface design teams from different products within a product family inspect the design of a new product user interface to ensure consistency across the product family
Formal Usability inspection	A formal review of the tasks that users will complete when using the product; formal definition of roles and tasks for the evaluation process
Guideline reviews / Standard inspections	An interface is inspected by an expert for adherence to some list of general user interface guidelines or standards.
Heuristic evaluation	A HE involves a small set of evaluators examining the interface and judging its compliance with recognized usability principles, the so-called heuristics, in order to identify and resolve potential usability problems.
Human performance models (GOMS)	GOMS: family of techniques proposed by Card, Moran, and Newell (1983), for modeling and describing human task performance
Interface Design Patterns	Interface design patterns are solutions to frequently occurring problems and situation in the design of interfaces. The end users and the implementation teams conceptualize the interfaces in terms of interface design patterns.
Log Analysis / Web Usage Mining	Application of data mining techniques to discover usage patterns from Web data (Server Log Data, Search Log Data), in order to understand and better serve the needs of Web-based applications.
Parallel design	Parallel design is a method where alternative designs are created by two to four design groups at the same time. The aim is to assess the different ideas before settling on a single concept for continued development. The design groups work independently of each other, since the goal is to generate as much diversity as possible.
Participatory Design	A Participatory Design (PD) workshop is one in which developers, business representatives and/or users work together to design a solution. Implemented as an overall design philosophy, PD involves the user becoming an actual member of the design team.
Prioritization exercise	Make a "Big List of Things To Do". Organize your list according to Dependencies and Baseline items. Have the appropriate coworkers score each item (Technical Feasibility, Creative Feasibility, Importance to the User, and Importance to the Business). Graph the overall scores.
Prototyping methods	A prototype is a concrete but partial implementation of a system being developed, in order to save time and costs related to making design ideas more palpable.
Computer-based (Rapid) Prototyping	This method supports the development and exploration of different design concepts through software prototypes. This form of prototyping has grown increasingly popular with the advent of rapid prototyping tools and development environments, which make it relatively simple to create a simulation of a proposed system.
Paper Prototyping	This method features the use of simple materials and equipment to create a paper-based simulation of an interface or system with the aim of exploring user requirements.

Video Prototyping	This method allows designers to create a video-based simulation of interface functionality using simple materials and equipment. Interface elements are created using paper, pens, acetates etc. For example, a start state for the interface is recorded using a standard camcorder. The movements of a mouse pointer over menus may then be simulated by stopping and starting the camcorder as interfaces elements are moved, taken away and added. Users do not directly interact with the prototype although they can view and comment on the completed video-based simulation.
Wireframe Prototyping	A wireframe is a basic, architectural outline of an individual page, indicating the elements of the page, their grouping and relationships, and their relative importance. Wireframes thus can be viewed as structural, medium fidelity prototypes of individual pages. In order to keep the design as simple as possible and to allow for rapid iterations, few if any visuals are used within the wire frame.
Scenario building exercise	A scenario is a description of a person's interaction with a system. They offer concrete representations of a user working with a computer system in order to achieve a particular goal. Scenarios may be developed with users to establish how they would like or not like to interact with the system (in general terms).
Storyboarding	A storyboard is a low fidelity prototype consisting of a series of screen sketches. They are used by designers to illustrate and organize their ideas and obtain feedback. They are particularly useful for multi-media presentations.
Task Allocation charts	Task allocation decisions determine the extent to which a given job, task, function or responsibility is to be automated or assigned to a human. The decisions are based on many factors, such as relative capabilities and limitations of human versus technology in terms of reliability, speed, accuracy, strength, flexibility of response, cost, and the importance of successful or timely accomplishment of tasks.
Testing methods	A set of methods to evaluate aspects of a product by having participants perform relevant tasks with the product, or prototypes of the product.
Card-based classification evaluation	For one scenario, the participant is presented an index card with a list of the first level navigation items. The participant chooses an element that he would follow to complete the task of the scenario, then he is presented an index card with the second level navigation items for the first level element he has chosen, then he again chooses, ...
Co-operative evaluation	This is a cost-effective technique for identifying usability problems in prototype products and processes. Users work with a prototype as they carry out tasks set by the design team. During this procedure, users explain what they are doing by talking or 'thinking-aloud'. An observer records unexpected user behavior and the user's comments regarding the system. The observer also actively questions the user with respect to their intentions and expectations.
Performance measurement	Performance testing is a rigorous usability evaluation of a working system under realistic conditions to identify usability problems and to compare measures such as success rate, task time and user satisfaction with requirements.
Perceived IA Test	After a user has been widely exposed to the web site or prototype, the user is provided with the opportunity to illustrate the structure of the web site. They are given a large sheet of paper and a lot of different colored pens and markers. They do not have access to the web site or software at this time. Users are free to express their knowledge any way they want. They can use boxes, words, labels, words, colors, or anything else they want, to display their knowledge visually.
Structure evaluation	The Structure is presented to the user with sheets of paper on a table; on the reverse of each sheet is the list of items that the structure element contains. A participant is presented with an index card representing an item: The participant attempts to locate the item in the structure
Usability test	A process in which representatives of a target audience are employed to evaluate a product's usability by observing them as they interact with the product and perform typical tasks.
Wizard of Oz technique	This variant of computer-based prototyping involves a user interacting with a computer system that is actually operated by a hidden developer - referred to as the 'wizard'. The wizard processes input from a user and simulates system output.
Usability Context Analysis	Usability Context Analysis is a structured method for eliciting detailed information about a product and how it will be used, and for deriving a plan for a user based evaluation of a product. In this method stakeholders attend a facilitated meeting to detail the actual circumstances (or intended use) of a product.

User Profile Analysis/ Persona Development	Persona: A fictitious person for whom you are designing; represents the archetypal qualities of your audience
Walkthrough methods	A set of methods for evaluating a system by envisioning the user's route through an early concept or prototype of the product, and noting problems as the interaction proceeds.
Cognitive Walkthrough	A walkthrough in which the responsible designer presents the interface to other members of the team or peers, and guides them through actual user tasks, step by step. The analysts then identify potential difficulties and raise concerns about any aspect of the system.
Pluralistic Walkthrough	User, developers, and usability experts step through a design together based on a test task, discussing usability issues as they arise
Usability Walkthrough	Users, developers and usability specialists review a set of designs individually, and then meet to discuss each element of the design in turn.
Workshop methods	A set of methods in which several individuals come together to identify and discuss issues, generate and prioritize ideas, or give feedback.
Brainstorming	Brainstorming is one of the oldest known methods for generating group creativity. A group of people come together and focus on a problem or proposal. There are two phases of the activity. The first phase generates ideas, the second phase evaluates them. An experienced facilitator is useful.
Focus Group / Group discussion	Focus groups are moderated discussion groups typically used early in a design process, e.g., to identify user goals, tasks, and needs, discuss competitor products, prioritize features, or generate design ideas. However, they can also be employed to collect customer feedback. Participants typically include six to nine representatives of the target audience of the product.
Stakeholder meeting	A stakeholder meeting is a strategic way to derive usability objectives from business objectives, and to gain commitment to usability. It also collects information about the purpose of the system and its overall context of use.

Appendix C-3: IA Methods Description List: Benefits and Shortcomings

Method	Benefits	Shortcomings
Affinity Diagramming	<ul style="list-style-type: none"> Simple Powerful for grouping and understanding information Provides a good way to identify and analyze issues. Best used if the work can be followed up quickly 	
Best Practice/ Competitive Analysis		
Blueprints	<ul style="list-style-type: none"> Communicating architectural approaches to clients and team members to spark discussion and get buy-in. Serve the production team to be able to implement the IA without a need for constant physical presence of the information architect 	<ul style="list-style-type: none"> For very large sites, detailed blueprints can become inefficient, Organization documentation blueprints are not suited for portraying highly functional, non-static websites;
Card Sorting	<ul style="list-style-type: none"> Good for identifying user's view of the information space and differences between novice and expert users Can be done remotely Simple and effective Well understood Cheap and quick to use Quick to apply, which allows more users to be involved. 	<ul style="list-style-type: none"> Users' models are not always the optimal solution Users often widely disagree in labeling categories Does not account for: business requirements, strategic directions, technical goals and limitations, and usability guidelines limits user to develop a single structure

	<ul style="list-style-type: none"> ▪ Avoids directly asking users. ▪ Promotes users' buy-in to project ▪ Forces participants to bottom-up thinking and to also address less important items ▪ Also are well suited for identifying labels that might be misunderstood or items that might be hard to find, and differences between novice and expert users' conceptual models 	
Consolidated Assessment	<ul style="list-style-type: none"> ▪ Environment is more reflective of users' real-life activities; more 'lively and engaging' ▪ More meaningful results ▪ Improved efficiency (single logistics planning and recruiting, single test script, one findings presentation) 	
Content Inventory	<ul style="list-style-type: none"> ▪ Detailed view of the site's content ▪ Immeasurably important when synthesizing or re-architecting an overall content structure. ▪ Vital to do if the site is not in a content management system 	<ul style="list-style-type: none"> ▪ tedious, ▪ time-consuming ▪ pure drudgery
Critical Incident Technique		
Diary keeping	<ul style="list-style-type: none"> ▪ Allows data to be captured about every day tasks, without researcher intrusion 	<ul style="list-style-type: none"> ▪ Users may forget to complete their diary or fail to complete it properly if insufficient instruction is given
End User Feedback Analysis		
Entity Relationship Diagrams (ERD)	<ul style="list-style-type: none"> ▪ 	
Field study (observational methods)	<ul style="list-style-type: none"> ▪ Probably the truest and most accurate appraisals of usability since the actual user, product, and environment are all in place and interacting with each other. 	
Free Listing		
Functionality matrix	<ul style="list-style-type: none"> ▪ Can be tailored to suit varying design processes and in-house styles. ▪ Allows different user types to be considered together in a single process. ▪ Superfluous functions are identified. ▪ Represents a reference in subsequent product lifecycle stages and may be updated in the light of prototyping ▪ Allows for both seeing the big picture and the details ▪ Physicality of paper and wall encourages conversation and collaboration 	<ul style="list-style-type: none"> ▪ Prime focus is on functions and features rather than interface appearance. ▪ Can be cumbersome for large numbers of functions ▪ Can get out of sync if there are multiple versions ▪ Large format printers are expensive
Inquiry methods		
Interview	<ul style="list-style-type: none"> ▪ Well suited for assessing actual usage, subjective satisfaction, and anxieties ▪ Especially useful for exploring domains not well known yet to the researcher ▪ Areas which require more detailed analysis can be adaptively followed in the same session ▪ Quick and relatively cheap to carry out, compared to observational methods 	<ul style="list-style-type: none"> ▪ The interviewer may need to acquire extensive domain knowledge prior to interviews. ▪ What users say depends largely on the skill of the interviewer to ask questions correctly. ▪ Interviewees can have difficulties in articulating their concerns. ▪ What interviewees say may differ from reality (e.g., due to social desirability bias) ▪ Interviewers may put their own biased inter-

	<ul style="list-style-type: none"> ▪ Close contact to users frequently returns ready-to-implement design recommendations ▪ Can promote 'buy-in' as users come to feel that their views are being taken account of ▪ Yields a wealth of data 	<ul style="list-style-type: none"> ▪ pretation on what is said. ▪ Analysis of resulting audio or written data can be very time-consuming. ▪ Interviewing only a small fraction of the overall user population can lead to biased results ▪ Not good for assessing actual behaviors
Contextual Inquiry	<ul style="list-style-type: none"> ▪ Good for understanding the context of work, for learning about unknown domains ▪ Uncovers a wealth of invaluable data 	<ul style="list-style-type: none"> ▪ time-consuming
Task Analysis	<ul style="list-style-type: none"> ▪ Provides knowledge of the tasks that the user wishes to perform. Thus, it is a reference against which the value of the system functions and features can be tested. 	<ul style="list-style-type: none"> ▪ Formal task analysis can be time consuming and produce much data requiring considerable effort to analyze.
Questionnaire	<ul style="list-style-type: none"> ▪ questionnaires can easily be administered to large sample sizes ▪ compared to interviews, questionnaires are better suited for returning numerical results ▪ especially closed questionnaires are less laborious to perform and to analyze ▪ are not as subjected to scheduling constraints as interviews 	<ul style="list-style-type: none"> ▪ not as flexible as interviews in adapting to a individual respondent's concerns ▪ cannot be as free-form as interviews (e.g., not spontaneously adding follow-up questions) ▪ do not generate immediate results as interviews do ▪ questionnaires are subjected to response delays ▪ questionnaires frequently suffer from a low response rate
Survey	<ul style="list-style-type: none"> ▪ Good for assessing users' subjective satisfaction, possible anxieties, reasons for visiting the site ▪ uses larger sample sizes than focus groups to generalize to an entire population ▪ Quick, simple, and relatively inexpensive to administer (but not to design). ▪ Results can be subjected to statistical analysis, yielding quantitative data 	<ul style="list-style-type: none"> ▪ Less apt for feedback on design ideas ▪ Biased responses ▪ Too much information from those who are coping with their jobs, and too little from those who aren't ▪ Cannot match the focus group in its ability to seek for in-depth responses and rationale ▪ Survey design is not straightforward and experienced guidance is needed. ▪ May be hard to follow up on interesting comments as it is often not desirable or possible to keep records of respondents.
Inspection methods	<ul style="list-style-type: none"> ▪ High cost-efficiency ▪ Reliable and quick results ▪ Do not require much human factors expertise in data analysis ▪ Appropriate to also address lower-level design trade-offs ▪ Help to improve organizational acceptance of usability efforts as a whole ▪ Good when resource constraints do not allow usability testing 	<ul style="list-style-type: none"> ▪ Might call attention to atypical problems ▪ Fail to identify all critical or deeply hidden issues ▪ It is hard to keep them focused on specific evaluation objectives ▪ They hardly deliver quantitative data ▪ Rely heavily on the evaluator's individual ability to identify problems ▪ Do not help much in generating design solutions ▪ Cannot substitute for usability testing
Consistency inspections		
Formal Usability inspection	<ul style="list-style-type: none"> ▪ Formalization improves efficiency of method 	
Guideline reviews / Standard inspections		
Heuristic evaluation	<ul style="list-style-type: none"> ▪ Provides quick and relatively cheap feedback to designers and an estimate on 	<ul style="list-style-type: none"> ▪ Usually identifies problems which are rather easy to demonstrate, while maybe missing

	<p>how much a user interface can be improved</p> <ul style="list-style-type: none"> ▪ They are easy to perform, and thus, well suited for “discount usability engineering” ▪ They can be performed early on in the design process, e.g. with paper prototypes ▪ Results of heuristic evaluations may spark off ideas for how to improve the system ▪ They yield a good estimate for how much the system can be improved ▪ They can guide subsequent testing with users ▪ They help to ensure compatibility with other equally approved systems 	<p>other critical, but more hidden problems</p> <ul style="list-style-type: none"> ▪ The method can seem overly critical as it is normally not used to identify the 'good' aspects. ▪ Can be very time-consuming to check conformance to voluminous written guidelines ▪ Relies on the expert's knowledge of those guidelines and his/her ability to identify non-conformances 'on-the-fly'. ▪ Quality of results depends on the capability of the experts who conduct the evaluation.
Human performance models (GOMS)	<ul style="list-style-type: none"> ▪ Yields valid predictions ▪ Helps to discover usability problems not found by other methods and to reduce task execution time ▪ Can be economically advantageous to use such a predictive model ▪ Easy to construct a simple GOMS model ▪ Saves development time ▪ Saves the user time by reducing the learning time required to manipulate the system 	<ul style="list-style-type: none"> ▪ Three restrictions: 1. task must be representable in a procedural format., 2. can only represent routine cognitive skills, 3. the analyst must start with a list of top-level tasks or user goals ▪ GOMS's assumption of error-free performance is not adequate for novice users or leading edge technology systems ▪ Accuracy with respect to real users reduces with the level of granularity of the analysis performed
Interface Design Patterns		
Log Analysis / Web Usage Mining	<ul style="list-style-type: none"> ▪ Good for: ▪ creating user profiles, ▪ identifying user navigation patterns, ▪ predicting user behavior, ▪ comparing expected and actual web site usage, ▪ adjusting and personalizing web site to the interests of its users, ▪ supporting business / marketing decisions 	<ul style="list-style-type: none"> ▪ Privacy Issues ▪ Actual user behavior not observable ▪ Biasing factors: cache, aborted sessions, response delays, inadequate information presentation
Parallel design	<ul style="list-style-type: none"> ▪ Quick ▪ Cost effective ▪ Allows several approaches to be explored at the same time, thus compressing the concept development schedule. ▪ The concepts generated can often be combined so that the final system benefits from all ideas proposed. ▪ Only minimal resources and materials are required to convey product feel ▪ Little or no human factors expertise necessary 	<ul style="list-style-type: none"> ▪ Requires a number of design team members to be available at the same time to produce system concepts. ▪ Requires a lot of time over a short period for the design work to be carried out. ▪ Time is also needed to compare parallel design outputs properly so that the benefits of each approach are obtained
Participatory Design	<ul style="list-style-type: none"> ▪ Gives users a voice in the design process, thus increasing the probability of a usable design ▪ Ensure solid solutions that meet the functional needs of end users Allows for equal participation of technical and non-technical participants ▪ Foster collaboration between, and mutual learning from, users, designers, and 	<ul style="list-style-type: none"> ▪ Users might adapt to the team's way of thinking, thus diminishing the value of their input ▪ Users might withhold too negative criticism to avoid admonishing their colleagues ▪ Users are not necessarily good designers, and cannot account for all design constraints ▪ The integration of user representatives instead of real users might lead to false conclusions

	<ul style="list-style-type: none"> ▪ developers ▪ Provides a forum for identifying issues ▪ Improve acceptance and adoption of the system, and buy-in from end users ▪ Very productive ▪ Easy to conduct 	<ul style="list-style-type: none"> ▪ May miss key success factors, e.g., brand image or economic constraints on production
Prioritization exercise		
Prototyping	<ul style="list-style-type: none"> ▪ Saves time and costs related to making design ideas more palpable 	
Computer-based (Rapid) Prototyping	<ul style="list-style-type: none"> ▪ Permits the swift development of interactive software prototypes. ▪ High fidelity with the final product. ▪ Supports metric-based evaluations. 	<ul style="list-style-type: none"> ▪ Requires software development skills. ▪ More time consuming than paper-based approaches. ▪ Greater resources required ▪ Due to the greater investment in skills and time there may be reluctance to additional design iterations
Paper Prototyping	<ul style="list-style-type: none"> ▪ Good for collecting feedback, validating designs, identifying problematic issues early on ▪ Potential usability problems can be detected at a very early stage in the design process before any code has been written. ▪ Communication between designers and users is promoted. ▪ Only minimal resources and materials are required, thus minimizing reluctance to design iterations. ▪ Little or no human factors expertise necessary ▪ Cost effective ▪ Supports participatory design activities ▪ Distinct separation of design- and development activities, thus allowing for easy iteration 	<ul style="list-style-type: none"> ▪ Do not support the evaluation of fine design detail. ▪ Cannot reliably simulate system response times or be used to deliver metric data. ▪ The individual playing the role of the computer must be fully aware of the functionality of the intended system in order to simulate the computer.
Video Prototyping	<ul style="list-style-type: none"> ▪ Good for identifying problematic issues early on ▪ Provides a dynamic simulation of interface elements that can be viewed and commented on by both design teams and intended users. ▪ Minimal resources and materials required. ▪ little or no human factors expertise necessary 	<ul style="list-style-type: none"> ▪ Staff familiar with the functionality of the intended system are required to create the video prototype. ▪ The method does not actually capture a user interacting with the prototype. ▪ Do not support the evaluation of fine design detail.
Wireframe Prototyping	<ul style="list-style-type: none"> ▪ demonstrates a site concept quickly ▪ effectively guide visual design efforts to prototype and include changes more quickly ▪ help to communicate the IA system to clients, allows clients to react to content placement and rendering ▪ allows for usability testing early in the project lifecycle ▪ can elaborate on a singular vision for the site ▪ can facilitate collaboration between design team and information architects ▪ is easy for clients to understand ▪ can serve as a checklist for content- 	<ul style="list-style-type: none"> ▪ hinders creativity and innovation by imposing (real or imagined) limits on design team ▪ distracts client from tasks at hand: evaluating page priorities, understanding information relationships ▪ is not necessarily HTML-ready if not developed to scale or without "chrome" ▪ does not provide accurate usability testing results ▪ relies on other documentation to provide a complete picture ▪ does not consider color, typography, and other brand identity elements ▪ requires time to wrestle with layout details, which might change in final design anyway

	<ul style="list-style-type: none"> gathering, -development and status tracking can flesh out a singular vision for the site can act as a starting point for developing text-only versions of the website 	<ul style="list-style-type: none"> they are not stand-alone deliverables of an IA specification
Scenarios, scenario building exercise	<ul style="list-style-type: none"> Good for describing a system interaction from the user's perspective, for removing focus from technology in order to open up design possibilities, and for ensuring that technical or budgetary constraints do not override usability constraints without due consideration. Allows for a holistic description of the user's experience Excellent communication tool – all humans understand stories Works well across multi-disciplinary teams Fleshes out persona's "existence" 	<ul style="list-style-type: none"> Not appropriate for considering the details of interface design and layout.
Storyboarding	<ul style="list-style-type: none"> Good for making a task flowchart meaningful, expressing discrete interactions Feedback can be gained on system functionality, style and also navigation options early on in the development cycle where changes can be more easily implemented. Quick and easy Minimal resources and materials required. Little or no human factors expertise necessary simple enough to not be mistaken for page designs; complex enough to provide a clear vision of what the site will be like The method promotes communication between designers and users. 	<ul style="list-style-type: none"> Can lack the interactive quality of other prototyping methods although interactive storyboarding systems are available. Do not support the evaluation of fine design detail. Do not accurately convey system response times Sometimes mistaken for actual design
Task Allocation charts	<ul style="list-style-type: none"> Counteracts the tendency to try and computerize the whole of a working system leaving users to carry out the remaining tasks regardless of the kinds of jobs this produces. 	<ul style="list-style-type: none"> Requires some concept of the new system for users to contribute to the process and generate new options.
Testing methods		
Card-based classification evaluation	<ul style="list-style-type: none"> Quick Get people to participate easily Get a lot of participants Cover many scenarios and much of the classification. Change the classification as you go or test alternatives on the fly. Rerun the evaluation whenever you make changes. Gather valuable information about how people think. The wrap-up at the end is especially useful for getting additional feedback from participants. 	
Co-operative evaluation	<ul style="list-style-type: none"> Can detect usability problems early in the design process. Yields Information on the user's thought 	<ul style="list-style-type: none"> Can be very time consuming to analyze. The close involvement of designers in this evaluation technique makes it unsuitable in

	<ul style="list-style-type: none"> processes as well as their actions Communication between designers and users is promoted. Little or no human factors training necessary 	circumstances that require an independent assessment, such as quality assurance.
Performance measurement		
Perceived IA Test	<ul style="list-style-type: none"> Good for understanding users' view of the site and its information architecture Focuses on the user's subjective interpretation of how the site is structured Participants can use several modalities can to express their view 	<ul style="list-style-type: none"> Participants might only re-draw the actual structure, not their interpretation results are not very detailed
Structure evaluation	<ul style="list-style-type: none"> Simple Cost-effective Good for assessing if user find items in the structure Flexible to accommodate design changes does not require a full prototype yields "hard", quantitative data 	
Usability test	<ul style="list-style-type: none"> High cost-efficiency in identifying critical usability problems Allows for addressing specific evaluation objectives Allows for comparison with previous versions, competitor products, or benchmark values Effectively generates recommendations for change Few human factors expertise required in data analysis Allows for high-level guidance of the underlying design process Facilitates organizational buy-in to usability efforts 	<ul style="list-style-type: none"> Might be too time-consuming for short-term projects and small-scale design problems Interpersonal and human factors skills of the observer are critical in conducting tests Validity of results is dependent on how close the overall test setting is to real-life use Becomes less cost-efficient the more costly it is to create a realistic context Direct observation of users might be obtrusive and change a person's actual behavior Data analysis of notes and video tape recordings are time-consuming and mostly have to be done personally by the note taker, which reduces cost-efficiency
Wizard of Oz technique		
Usability Context Analysis	<ul style="list-style-type: none"> Offers a framework to ensure that all factors that may affect usability are identified before design work starts. Context meetings bring together all the people relevant to a development program, early on in the project. It also helps to ensure that evaluation activities produce valid results, by specifying how important factors are to be handled in an evaluation, and by defining how well the evaluation reflects real world use. For comparative evaluations the method documents the circumstances of each evaluation (e.g. for comparisons between novice and expert groups of users). 	<ul style="list-style-type: none"> Success of this method depends upon competent chairing to keep the meeting focused on the relevant issues. Familiarity with the Context of Use questionnaire by the chairperson is essential. Context meetings can be difficult to arrange because of the number and type of people usually involved. Context meetings can be frustrating without competent chairing, and the key issues can be hard to identify.
User Profile Analysis/ Persona Development	<ul style="list-style-type: none"> Provides focus for the design Humanizes the design Effective for bringing user-centered design into an organization Helps to get past personal opinions and presumptions to understand what users truly need 	
Walkthrough	<ul style="list-style-type: none"> Very cost-efficient, especially in identi- 	<ul style="list-style-type: none"> Not well-suited for evaluating actual ease of

methods	<p>fying misconceptions about user task flows, system navigation, wording problems, and inadequate system feedback</p> <ul style="list-style-type: none"> ▪ Good for testing gross navigation, for early and informal validation of design decisions, for feedback from several people at once, and when resource constraints do not allow formal testing. ▪ Flexible means of obtaining reactions, allowing the users' discussion to range over issues not originally considered. 	<p>use, especially for expert usage</p> <ul style="list-style-type: none"> ▪ tend to identify rather specific than generic problems, and may fail to reveal all of the severe deficiencies ▪ Requires some form of prototype to show and for user to react to. ▪ Results are opinions rather than objective data. ▪ Users may tend to react positively on seeing some prototype in operation. ▪ It may be difficult to imagine how the system will operate in the real environment ▪ A significant weakness of paper-based walkthroughs is the fact that they do not show interactive behavior.
Cognitive Walkthrough	<ul style="list-style-type: none"> ▪ Identifies mismatches in the conceptualization of users, their tasks, wording, and inadequate feedback 	<ul style="list-style-type: none"> ▪ Only good for evaluating ease of use; cannot address ease of learning ▪ Identifies rather specific than general problems, might miss severe problems
Pluralistic Walkthrough	<ul style="list-style-type: none"> ▪ Good for early assessment of user performance and satisfaction ▪ Quick ▪ Cost-effective ▪ no prototype necessary ▪ with prototype, it allows for rapid test-retest iterations ▪ Allows for redesign on the fly ▪ yields results not achieved with testing methods ▪ Allows for rapid feedback and confirmation of issues from each of the three participating stakeholders ▪ Promotes user buy-in 	<ul style="list-style-type: none"> ▪ Speed of the method is dependent on the slowest participant ▪ Only parts of the overall product are evaluated ▪ Even if several solutions are possible, only one is addressed
Usability Walkthrough	<ul style="list-style-type: none"> ▪ Detailed user feedback can be obtained quickly and at little expense. ▪ The feedback can be obtained on paper designs before significant development work is undertaken. ▪ The walkthrough meeting provides a mechanism to build rapport between users and members of the development team. 	<ul style="list-style-type: none"> ▪ Users may be too shy to speak their mind and offer criticisms. ▪ The paper designs that are typically used with this method may not be sufficiently detailed to enable users to appreciate how things will actually work in practice, so the feedback they give must be treated with care.
Workshop methods		
Brainstorming	<ul style="list-style-type: none"> ▪ The group process is usually perceived as rewarding in itself ▪ Creates a feeling of ownership of the result. ▪ In the brainstorming process, everybody in the group can take credit for the good ideas. ▪ It does not take long to obtain useful data and the session need not take more than one hour. 	<ul style="list-style-type: none"> ▪ Some studies show that people working in isolation produces more and better ideas than when working as a group.
Focus Group (group discussion)	<ul style="list-style-type: none"> ▪ Allows the analyst to rapidly obtain a wide variety of views from a range of people with widely differing but relevant perspectives ▪ Help to summarize the ideas and information held by individual members ▪ Each participant can act to stimulate 	<ul style="list-style-type: none"> ▪ Social factors such as peer pressure may lead to inaccurate reports or participants being inhibited. ▪ Some people may also not always think creatively in a group setting and prefer to be interviewed or to complete a survey form in their own time

	<div>ideas in the other people present</div> <div>▪ By a process of discussion, the collective view becomes established which is greater than the individual parts</div>	
Stakeholder meeting		